THERMAL ARC®

# 160TS

# P-WEE®

## INVERTER ARC WELDER

Art # A-05870

# Service Manual

**Version No: AA** **Issue Date:** August 12, 2005 **Manual No.:** 0-4754

**Operating Features:**

MMAW | GTAW | 160 AMP | CC | DC | 1 PHASE | 230 V

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This Operating Manual has been designed to instruct you on the correct use and operation of your Thermal Arc product. Your satisfaction with this product and its safe operation is our ultimate concern. Therefore please take the time to read the entire manual, especially the Safety Precautions. They will help you to avoid potential hazards that may exist when working with this product.

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Above all, we are committed to develop technologically advanced products to achieve a safer working environment within the welding industry.

***WARNINGS***

*Read and understand this entire Manual and your employer's safety practices before installing, operating, or servicing the equipment.*

*While the information contained in this Manual represents the Manufacturer's best judgement, the Manufacturer assumes no liability for its use.*

P-Wee 160TS Inverter Arc Welding Power Supply
Instruction Manual Number 0-4754 for:
Spec Number 103067

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82 Benning Street
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(603) 298-5711

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Publication Date: August 12, 2005

**Record the following information for Warranty purposes:**

Where Purchased: _____

Purchase Date: _____

Equipment Serial #: _____

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# SECTION 1:
# SAFETY INSTRUCTIONS AND WARNINGS

***WARNING***

**PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. PACEMAKER WEARERS KEEP AWAY UNTIL CONSULTING YOUR DOCTOR. DO NOT LOSE THESE INSTRUCTIONS. READ OPERATING/INSTRUCTION MANUAL BEFORE INSTALLING, OPERATING OR SERVICING THIS EQUIPMENT.**

Welding products and welding processes can cause serious injury or death, or damage to other equipment or property, if the operator does not strictly observe all safety rules and take precautionary actions.

Safe practices have developed from past experience in the use of welding and cutting. These practices must be learned through study and training before using this equipment. Some of these practices apply to equipment

connected to power lines; other practices apply to engine driven equipment. Anyone not having extensive training in welding and cutting practices should not attempt to weld.

Safe practices are outlined in the American National Standard Z49.1 entitled: SAFETY IN WELDING AND CUTTING. This publication and other guides to what you should learn before operating this equipment are listed at the end of these safety precautions. **HAVE ALL INSTALLATION, OPERATION, MAINTENANCE, AND REPAIR WORK PERFORMED ONLY BY QUALIFIED PEOPLE.**

## 1.01 Arc Welding Hazards

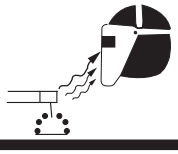
***WARNING***

***ELECTRIC SHOCK can kill.***

*Touching live electrical parts can cause fatal shocks or severe burns. The electrode and work circuit is electrically live whenever the output is on. The input power circuit and machine internal circuits are also live when power is on. In semiautomatic or automatic wire welding, the wire, wire reel, drive roll housing, and all metal parts touching the welding wire are electrically live. Incorrectly installed or improperly grounded equipment is a hazard.*

1. Do not touch live electrical parts.
2. Wear dry, hole-free insulating gloves and body protection.
3. Insulate yourself from work and ground using dry insulating mats or covers.
4. Disconnect input power or stop engine before installing or servicing this equipment. Lock input power disconnect switch open, or remove line fuses so power cannot be turned on accidentally.
5. Properly install and ground this equipment according to its Owner's Manual and national, state, and local codes.
6. Turn off all equipment when not in use. Disconnect power to equipment if it will be left unattended or out of service.
7. Use fully insulated electrode holders. Never dip holder in water to cool it or lay it down on the ground or the work surface. Do not touch holders connected to two welding machines at the same time or touch other people with the holder or electrode.
8. Do not use worn, damaged, undersized, or poorly spliced cables.
9. Do not wrap cables around your body.
10. Ground the workpiece to a good electrical (earth) ground.

11. Do not touch electrode while in contact with the work (ground) circuit.
12. Use only well-maintained equipment. Repair or replace damaged parts at once.
13. In confined spaces or damp locations, do not use a welder with AC output unless it is equipped with a voltage reducer. Use equipment with DC output.
14. Wear a safety harness to prevent falling if working above floor level.
15. Keep all panels and covers securely in place.



***WARNING***

*ARC RAYS can burn eyes and skin; NOISE can damage hearing.*

*Arc rays from the welding process produce intense heat and strong ultraviolet rays that can burn eyes and skin. Noise from some processes can damage hearing.*

1. Wear a welding helmet fitted with a proper shade of filter (see ANSI Z49.1 listed in Safety Standards) to protect your face and eyes when welding or watching.
2. Wear approved safety glasses. Side shields recommended.
3. Use protective screens or barriers to protect others from flash and glare; warn others not to watch the arc.
4. Wear protective clothing made from durable, flame-resistant material (wool and leather) and foot protection.
5. Use approved ear plugs or ear muffs if noise level is high.

***WARNING***

*FUMES AND GASES can be hazardous to your health.*

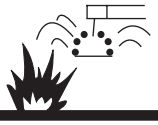
*Welding produces fumes and gases. Breathing these fumes and gases can be hazardous to your health.*

1. Keep your head out of the fumes. Do not breath the fumes.
2. If inside, ventilate the area and/or use exhaust at the arc to remove welding fumes and gases.
3. If ventilation is poor, use an approved air-supplied respirator.
4. Read the Material Safety Data Sheets (MSDSs) and the manufacturer's instruction for metals, consumables, coatings, and cleaners.
5. Work in a confined space only if it is well ventilated, or while wearing an air-supplied respirator. Shielding gases used for welding can displace air causing injury or death. Be sure the breathing air is safe.

**Eye protection filter shade selector for welding or cutting (goggles or helmet), from AWS A6.2-73.**

| *Welding or cutting* | *Electrode Size* | *Filter* | *Welding or cutting* | *Electrode Size* | *Filter* |
|---|---|---|---|---|---|
| Torch soldering | | 2 | **Gas metal-arc** | | |
| Torch brazing | | 3 or 4 | Non-ferrous base metal | All | 11 |
| **Oxygen Cutting** | | | Ferrous base metal | All | 12 |
| Light | Under 1 in., 25 mm | 3 or 4 | Gas tungsten arc welding | All | 12 |
| Medium | 1 to 6 in., 25-150 mm | 4 or 5 | (TIG) | All | 12 |
| Heavy | Over 6 in., 150 mm | 5 or 6 | Atomic hydrogen welding | All | 12 |
| **Gas welding** | | | Carbon arc welding | All | 12 |
| Light | Under 1/8 in., 3 mm | 4 or 5 | Plasma arc welding | | |
| Medium | 1/8 to 1/2 in., 3-12 mm | 5 or 6 | **Carbon arc air gouging** | | |
| Heavy | Over 1/2 in., 12 mm | 6 or 8 | Light | | 12 |
| **Shielded metal-arc** | Under 5/32 in., 4 mm | 10 | Heavy | | 14 |
| | 5/32 to 1/4 in., | 12 | **Plasma arc cutting** | | |
| | Over 1/4 in., 6.4 mm | 14 | Light | Under 300 Amp | 9 |
| | | | Medium | 300 to 400 Amp | 12 |
| | | | Heavy | Over 400 Amp | 14 |

6. Do not weld in locations near degreasing, cleaning, or spraying operations. The heat and rays of the arc can react with vapors to form highly toxic and irritating gases.
7. Do not weld on coated metals, such as galvanized, lead, or cadmium plated steel, unless the coating is removed from the weld area, the area is well ventilated, and if necessary, while wearing an air-supplied respirator. The coatings and any metals containing these elements can give off toxic fumes if welded.

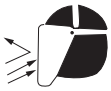


***WARNING***

*WELDING can cause fire or explosion.*

*Sparks and spatter fly off from the welding arc. The flying sparks and hot metal, weld spatter, hot workpiece, and hot equipment can cause fires and burns. Accidental contact of electrode or welding wire to metal objects can cause sparks, overheating, or fire.*

1. Protect yourself and others from flying sparks and hot metal.
2. Do not weld where flying sparks can strike flammable material.
3. Remove all flammables within 35 ft (10.7 m) of the welding arc. If this is not possible, tightly cover them with approved covers.
4. Be alert that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas.
5. Watch for fire, and keep a fire extinguisher nearby.
6. Be aware that welding on a ceiling, floor, bulkhead, or partition can cause fire on the hidden side.
7. Do not weld on closed containers such as tanks or drums.
8. Connect work cable to the work as close to the welding area as practical to prevent welding current from traveling long, possibly unknown paths and causing electric shock and fire hazards.
9. Do not use welder to thaw frozen pipes.
10. Remove stick electrode from holder or cut off welding wire at contact tip when not in use.



***WARNING***

*FLYING SPARKS AND HOT METAL can cause injury.*

*Chipping and grinding cause flying metal. As welds cool, they can throw off slag.*

1. Wear approved face shield or safety goggles. Side shields recommended.
2. Wear proper body protection to protect skin.

***WARNING***

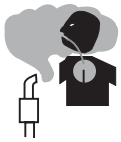
*CYLINDERS can explode if damaged.*

*Shielding gas cylinders contain gas under high pressure. If damaged, a cylinder can explode. Since gas cylinders are normally part of the welding process, be sure to treat them carefully.*

1. Protect compressed gas cylinders from excessive heat, mechanical shocks, and arcs.
2. Install and secure cylinders in an upright position by chaining them to a stationary support or equipment cylinder rack to prevent falling or tipping.
3. Keep cylinders away from any welding or other electrical circuits.
4. Never allow a welding electrode to touch any cylinder.
5. Use only correct shielding gas cylinders, regulators, hoses, and fittings designed for the specific application; maintain them and associated parts in good condition.
6. Turn face away from valve outlet when opening cylinder valve.
7. Keep protective cap in place over valve except when cylinder is in use or connected for use.
8. Read and follow instructions on compressed gas cylinders, associated equipment, and CGA publication P-1 listed in Safety Standards.

***WARNING***

*Engines can be dangerous.*



***WARNING***

*ENGINE EXHAUST GASES can kill.*

Engines produce harmful exhaust gases.

1. Use equipment outside in open, well-ventilated areas.
2. If used in a closed area, vent engine exhaust outside and away from any building air intakes.

***WARNING***

*ENGINE FUEL can cause fire or explosion.*

*Engine fuel is highly flammable.*

1. Stop engine before checking or adding fuel.
2. Do not add fuel while smoking or if unit is near any sparks or open flames.
3. Allow engine to cool before fueling. If possible, check and add fuel to cold engine before beginning job.
4. Do not overfill tank — allow room for fuel to expand.
5. Do not spill fuel. If fuel is spilled, clean up before starting engine.

***WARNING***

***MOVING PARTS can cause injury.***

Moving parts, such as fans, rotors, and belts can cut fingers and hands and catch loose clothing.

1. Keep all doors, panels, covers, and guards closed and securely in place.
2. Stop engine before installing or connecting unit.
3. Have only qualified people remove guards or covers for maintenance and troubleshooting as necessary.
4. To prevent accidental starting during servicing, disconnect negative (-) battery cable from battery.
5. Keep hands, hair, loose clothing, and tools away from moving parts.
6. Reinstall panels or guards and close doors when servicing is finished and before starting engine.

***WARNING***

*SPARKS can cause BATTERY GASES TO EXPLODE; BATTERY ACID can burn eyes and skin.*

Batteries contain acid and generate explosive gases.

1. Always wear a face shield when working on a battery.
2. Stop engine before disconnecting or connecting battery cables.
3. Do not allow tools to cause sparks when working on a battery.
4. Do not use welder to charge batteries or jump start vehicles.
5. Observe correct polarity (+ and –) on batteries.

***WARNING***

*STEAM AND PRESSURIZED HOT COOLANT can burn face, eyes, and skin.*

*The coolant in the radiator can be very hot and under pressure.*

1. Do not remove radiator cap when engine is hot. Allow engine to cool.
2. Wear gloves and put a rag over cap area when removing cap.
3. Allow pressure to escape before completely removing cap.

***WARNING***

*This product, when used for welding or cutting, produces fumes or gases which contain chemicals know to the State of California to cause birth defects and, in some cases, cancer. (California Health & Safety code Sec. 25249.5 et seq.)*

***NOTE***

*Considerations About Welding And The Effects of Low Frequency Electric and Magnetic Fields*

The following is a quotation from the General Conclusions Section of the U.S. Congress, Office of Technology Assessment, Biological Effects of Power Frequency Electric & Magnetic Fields - Background Paper, OTA-BP-E-63 (Washington, DC: U.S. Government Printing Office, May 1989): "...there is now a very large volume of scientific findings based on experiments at the cellular level and from studies with animals and people which clearly establish that low frequency magnetic fields and interact with, and produce changes in, biological systems. While most of this work is of very high quality, the results are complex. Current scientific understanding does not yet allow us to interpret the evidence in a single coherent framework. Even more frustrating, it does not yet allow us to draw definite conclusions about questions of possible risk or to offer clear science-based advice on strategies to minimize or avoid potential risks."

To reduce magnetic fields in the workplace, use the following procedures.

1. Keep cables close together by twisting or taping them.
2. Arrange cables to one side and away from the operator.
3. Do not coil or drape cable around the body.
4. Keep welding power source and cables as far away from body as practical.

***ABOUT PACEMAKERS:***

*The above procedures are among those also normally recommended for pacemaker wearers. Consult your doctor for complete information.*

## 1.02 PRINCIPAL SAFETY STANDARDS

Safety in Welding and Cutting, ANSI Standard Z49.1, from American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126.

Safety and Health Standards, OSHA 29 CFR 1910, from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Recommended Safe Practices for the Preparation for Welding and Cutting of Containers That Have Held Hazardous Substances, American Welding Society Standard AWS F4.1, from American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126.

National Electrical Code, NFPA Standard 70, from National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

Safe Handling of Compressed Gases in Cylinders, CGA Pamphlet P-1, from Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202.

Code for Safety in Welding and Cutting, CSA Standard W117.2, from Canadian Standards Association, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada M9W 1R3.

Safe Practices for Occupation and Educational Eye and Face Protection, ANSI Standard Z87.1, from American National Standards Institute, 1430 Broadway, New York, NY 10018.

Cutting and Welding Processes, NFPA Standard 51B, from National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

## 1.03 PRECAUTIONS DE SECURITE EN SOUDAGE A L'ARC

***MISE EN GARDE***

**LE SOUDAGE A L'ARC EST DANGEREUX**

**PROTEGEZ-VOUS, AINSI QUE LES AUTRES, CONTRE LES BLESSURES GRAVES POSSIBLES OU LA MORT. NE LAISSEZ PAS LES ENFANTS S'APPROCHER, NI LES PORTEURS DE STIMULATEUR CARDIAQUE (A MOINS QU'ILS N'AIENT CONSULTE UN MEDECIN). CONSERVEZ CES INSTRUCTIONS. LISEZ LE MANUEL D'OPERATION OU LES INSTRUCTIONS AVANT D'INSTALLER, UTILISER OU ENTRETENIR CET EQUIPEMENT.**

Les produits et procédés de soudage peuvent sauser des blessures graves ou la mort, de même que des dommages au reste du matériel et à la propriété, si l'utilisateur n'adhère pas strictement à toutes les règles de sécurité et ne prend pas les précautions nécessaires.

En soudage et coupage, des pratiques sécuritaires se sont développées suite à l'expérience passée. Ces pratiques doivent être apprises par étude ou entraînement avant d'utiliser l'equipement. Toute personne n'ayant pas suivi un entraînement intensif en soudage et coupage ne devrait pas tenter de souder. Certaines pratiques concernent les équipements raccordés aux lignes d'alimentation alors que d'autres s'adressent aux groupes électrogènes.

La norme Z49.1 de l'American National Standard, intitulée "SAFETY IN WELDING AND CUTTING" présente les pratiques sécuritaires à suivre. Ce document ainsi que d'autres guides que vous devriez connaître avant d'utiliser cet équipement sont présentés à la fin de ces instructions de sécurité.

SEULES DES PERSONNES QUALIFIEES DOIVENT FAIRE DES TRAVAUX D'INSTALLATION, DE REPARATION, D'ENTRETIEN ET D'ESSAI.

## 1.04 Dangers relatifs au soudage à l'arc

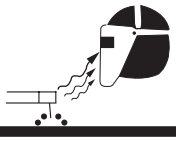
***AVERTISSEMENT***

***L'ELECTROCUTION PEUT ETRE MORTELLE.***

*Une décharge électrique peut tuer ou brûler gravement. L'électrode et le circuit de soudage sont sous tension dès la mise en circuit. Le circuit d'alimentation et les circuits internes de l'équipement sont aussi sous tension dès la mise en marche. En soudage automatique ou semi-automatique avec fil, ce dernier, le rouleau ou la bobine de fil, le logement des galets d'entrainement et toutes les pièces métalliques en contact avec le fil de soudage sont sous tension. Un équipement inadéquatement installé ou inadéquatement mis à la terre est dangereux.*

1. Ne touchez pas à des pièces sous tension.
2. Portez des gants et des vêtements isolants, secs et non troués.
3 Isolez-vous de la pièce à souder et de la mise à la terre au moyen de tapis isolants ou autres.
4. Déconnectez la prise d'alimentation de l'équipement ou arrêtez le moteur avant de l'installer ou d'en faire l'entretien. Bloquez le commutateur en circuit ouvert ou enlevez les fusibles de l'alimentation afin d'éviter une mise en marche accidentelle.
5. Veuillez à installer cet équipement et à le mettre à la terre selon le manuel d'utilisation et les codes nationaux, provinciaux et locaux applicables.
6. Arrêtez tout équipement après usage. Coupez l'alimentation de l'équipement s'il est hors d'usage ou inutilisé.
7. N'utilisez que des porte-électrodes bien isolés. Ne jamais plonger les porte-électrodes dans l'eau pour les refroidir. Ne jamais les laisser traîner par terre ou sur les pièces à souder. Ne touchez pas aux porte-électrodes raccordés à deux sources de courant en même temps. Ne jamais toucher quelqu'un d'autre avec l'électrode ou le porte-électrode.
8. N'utilisez pas de câbles électriques usés, endommagés, mal épissés ou de section trop petite.
9. N'enroulez pas de câbles électriques autour de votre corps.

10. N'utilisez qu'une bonne prise de masse pour la mise à la terre de la pièce à souder.
11. Ne touchez pas à l'électrode lorsqu'en contact avec le circuit de soudage (terre).
12. N'utilisez que des équipements en bon état. Réparez ou remplacez aussitôt les pièces endommagées.
13. Dans des espaces confinés ou mouillés, n'utilisez pas de source de courant alternatif, à moins qu'il soit muni d'un réducteur de tension. Utilisez plutôt une source de courant continu.
14. Portez un harnais de sécurité si vous travaillez en hauteur.
15. Fermez solidement tous les panneaux et les capots.



***AVERTISSEMENT***

*LE RAYONNEMENT DE L'ARC PEUT BRÛLER LES YEUX ET LA PEAU; LE BRUIT PEUT ENDOMMAGER L'OUIE.*

*L'arc de soudage produit une chaleur et des rayons ultraviolets intenses, susceptibles de brûler les yeux et la peau. Le bruit causé par certains procédés peut endommager l'ouïe.*

1. Portez une casque de soudeur avec filtre oculaire de nuance appropriée (consultez la norme ANSI Z49 indiquée ci-après) pour vous protéger le visage et les yeux lorsque vous soudez ou que vous observez l'exécution d'une soudure.
2. Portez des lunettes de sécurité approuvées. Des écrans latéraux sont recommandés.
3. Entourez l'aire de soudage de rideaux ou de cloisons pour protéger les autres des coups d'arc ou de l'éblouissement; avertissez les observateurs de ne pas regarder l'arc.
4. Portez des vêtements en matériaux ignifuges et durables (laine et cuir) et des chaussures de sécurité.
5. Portez un casque antibruit ou des bouchons d'oreille approuvés lorsque le niveau de bruit est élevé.

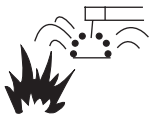
***AVERTISSEMENT***

*LES VAPEURS ET LES FUMEES SONT DANGEREUSES POUR LA SANTE.*

*Le soudage dégage des vapeurs et des fumées dangereuses à respirer.*

| SELECTION DES NUANCES DE FILTRES OCULAIRS POUR LA PROTECTION DES YEUX EN COUPAGE ET SOUDAGE (selon AWS á 8.2-73) | | | | | |
|---|---|---|---|---|---|
| Opération de coupage ou soudage | Dimension d'électrode ou Epiasseur de métal ou Intensité de courant | Nuance de filtre oculaire | Opération de coupage ou soudage | Dimension d'électrode ou Epiasseur de métal ou Intensité de courant | Nuance de filtre oculaire |
| Brassage tendre au chalumeau | toutes conditions | 2 | Soudage á l'arc sous gaz avec fil plein (GMAW) | | |
| Brassage fort au chalumeau | toutes conditions | 3 ou 4 | métaux non-ferreux | toutes conditions | 11 |
| Oxycoupage | | | métaux ferreux | toutes conditions | 12 |
| mince | moins de 1 po. (25 mm) | 2 ou 3 | Soudage á l'arc sous gaz avec électrode de tungstène (GTAW) | toutes conditions | 12 |
| moyen | de 1 á 6 po. (25 á 150 mm) | 4 ou 5 | Soudage á l'hydrogène atomique (AHW) | toutes conditions | 12 |
| épais | plus de 6 po. (150 mm) | 5 ou 6 | Soudage á l'arc avec électrode de carbone (CAW) | toutes conditions | 12 |
| Soudage aux gaz | | | Soudage á l'arc Plasma (PAW) | toutes dimensions | 12 |
| mince | moins de 1/8 po. (3 mm) | 4 ou 5 | Gougeage Air-Arc avec électrode de carbone | | |
| moyen | de 1/8 á 1/2 po. (3 á 12 mm) | 5 ou 6 | mince | | 12 |
| épais | plus de 1/2 po. (12 mm) | 6 ou 8 | épais | | 14 |
| Soudage á l'arc avec électrode enrobees (SMAW) | moins de 5/32 po. (4 mm) | 10 | Coupage á l'arc Plasma (PAC) | | |
| | 5/32 á 1/4 po. (4 á 6.4 mm) | 12 | mince | moins de 300 amperès | 9 |
| | plus de 1/4 po. (6.4 mm) | 14 | moyen | de 300 á 400 amperès | 12 |
| | | | épais | plus de 400 amperès | 14 |

1. Eloignez la tête des fumées pour éviter de les respirer.
2. A l'intérieur, assurez-vous que l'aire de soudage est bien ventilée ou que les fumées et les vapeurs sont aspirées à l'arc.
3. Si la ventilation est inadequate, portez un respirateur à adduction d'air approuvé.
4. Lisez les fiches signalétiques et les consignes du fabricant relatives aux métaux, aux produits consummables, aux revêtements et aux produits nettoyants.
5. Ne travaillez dans un espace confiné que s'il est bien ventilé; sinon, portez un respirateur à adduction d'air. Les gaz protecteurs de soudage peuvent déplacer l'oxygène de l'air et ainsi causer des malaises ou la mort. Assurez-vous que l'air est propre à la respiration.
6. Ne soudez pas à proximité d'opérations de dégraissage, de nettoyage ou de pulvérisation. La chaleur et les rayons de l'arc peuvent réagir avec des vapeurs et former des gaz hautement toxiques et irritants.
7. Ne soudez des tôles galvanisées ou plaquées au plomb ou au cadmium que si les zones à souder ont été grattées à fond, que si l'espace est bien ventilé; si nécessaire portez un respirateur à adduction d'air. Car ces revêtements et tout métal qui contient ces éléments peuvent dégager des fumées toxiques au moment du soudage.

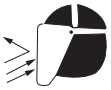


***AVERTISSEMENT***

*LE SOUDAGE PEUT CAUSER UN INCENDIE OU UNE EXPLOSION*

*L'arc produit des étincellies et des projections. Les particules volantes, le métal chaud, les projections de soudure et l'équipement surchauffé peuvent causer un incendie et des brûlures. Le contact accidentel de l'électrode ou du fil-électrode avec un objet métallique peut provoquer des étincelles, un échauffement ou un incendie.*

1. Protégez-vous, ainsi que les autres, contre les étincelles et du métal chaud.
2. Ne soudez pas dans un endroit où des particules volantes ou des projections peuvent atteindre des matériaux inflammables.
3. Enlevez toutes matières inflammables dans un rayon de 10, 7 mètres autour de l'arc, ou couvrez-les soigneusement avec des bâches approuvées.
4. Méfiez-vous des projections brulantes de soudage susceptibles de pénétrer dans des aires adjacentes par de petites ouvertures ou fissures.
5. Méfiez-vous des incendies et gardez un extincteur à portée de la main.
6. N'oubliez pas qu'une soudure réalisée sur un plafond, un plancher, une cloison ou une paroi peut enflammer l'autre côté.
7. Ne soudez pas un récipient fermé, tel un réservoir ou un baril.
8. Connectez le câble de soudage le plus près possible de la zone de soudage pour empêcher le courant de suivre un long parcours inconnu, et prévenir ainsi les risques d'électrocution et d'incendie.
9. Ne dégelez pas les tuyaux avec un source de courant.
10. Otez l'électrode du porte-électrode ou coupez le fil au tube-contact lorsqu'inutilisé après le soudage.
11. Portez des vêtements protecteurs non huileux, tels des gants en cuir, une chemise épaisse, un pantalon revers, des bottines de sécurité et un casque.



***AVERTISSEMENT***

*LES ETINCELLES ET LES PROJECTIONS BRULANTES PEUVENT CAUSER DES BLESSURES.*

*Le piquage et le meulage produisent des particules métalliques volantes. En refroidissant, la soudure peut projeter du éclats de laitier.*

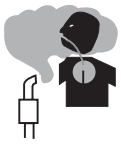
1. Portez un écran facial ou des lunettes protectrices approuvées. Des écrans latéraux sont recommandés.
2. Portez des vêtements appropriés pour protéger la peau.

***AVERTISSEMENT***

*LES BOUTEILLES ENDOMMAGEES PEUVENT EXPLOSER*

*Les bouteilles contiennent des gaz protecteurs sous haute pression. Des bouteilles endommagées peuvent exploser. Comme les bouteilles font normalement partie du procédé de soudage, traitez-les avec soin.*

1. Protégez les bouteilles de gaz comprimé contre les sources de chaleur intense, les chocs et les arcs de soudage.
2. Enchainez verticalement les bouteilles à un support ou à un cadre fixe pour les empêcher de tomber ou d'être renversées.
3. Eloignez les bouteilles de tout circuit électrique ou de tout soudage.
4. Empêchez tout contact entre une bouteille et une électrode de soudage.
5. N'utilisez que des bouteilles de gaz protecteur, des détendeurs, des boyauxs et des raccords conçus pour chaque application spécifique; ces équipements et les pièces connexes doivent être maintenus en bon état.
6. Ne placez pas le visage face à l'ouverture du robinet de la bouteille lors de son ouverture.
7. Laissez en place le chapeau de bouteille sauf si en utilisation ou lorsque raccordé pour utilisation.
8. Lisez et respectez les consignes relatives aux bouteilles de gaz comprimé et aux équipements connexes, ainsi que la publication P-1 de la CGA, identifiée dans la liste de documents ci-dessous.



***AVERTISSEMENT***

*LES MOTEURS PEUVENT ETRE DANGEREUX*

*LES GAZ D'ECHAPPEMENT DES MOTEURS PEUVENT ETRE MORTELS.*

Les moteurs produisent des gaz d'échappement nocifs.

1. Utilisez l'équipement à l'extérieur dans des aires ouvertes et bien ventilées.
2. Si vous utilisez ces équipements dans un endroit confiné, les fumées d'échappement doivent être envoyées à l'extérieur, loin des prises d'air du bâtiment.

***AVERTISSEMENT***

*LE CARBURANT PEUR CAUSER UN INCENDIE OU UNE EXPLOSION.*

*Le carburant est hautement inflammable.*

1. Arrêtez le moteur avant de vérifier le niveau e carburant ou de faire le plein.
2. Ne faites pas le plein en fumant ou proche d'une source d'étincelles ou d'une flamme nue.
3. Si c'est possible, laissez le moteur refroidir avant de faire le plein de carburant ou d'en vérifier le niveau au début du soudage.
4. Ne faites pas le plein de carburant à ras bord: prévoyez de l'espace pour son expansion.
5. Faites attention de ne pas renverser de carburant. Nettoyez tout carburant renversé avant de faire démarrer le moteur.

***AVERTISSEMENT***

*DES PIECES EN MOUVEMENT PEUVENT CAUSER DES BLESSURES.*

*Des pièces en mouvement, tels des ventilateurs, des rotors et des courroies peuvent couper doigts et mains, ou accrocher des vêtements amples.*

1. Assurez-vous que les portes, les panneaux, les capots et les protecteurs soient bien fermés.
2. Avant d'installer ou de connecter un système, arrêtez le moteur.
3. Seules des personnes qualifiées doivent démonter des protecteurs ou des capots pour faire l'entretien ou le dépannage nécessaire.

4. Pour empêcher un démarrage accidentel pendant l'entretien, débranchez le câble d'accumulateur à la borne négative.
5. N'approchez pas les mains ou les cheveux de pièces en mouvement; elles peuvent aussi accrocher des vêtements amples et des outils.
6. Réinstallez les capots ou les protecteurs et fermez les portes après des travaux d'entretien et avant de faire démarrer le moteur.

***AVERTISSEMENT***

*DES ETINCELLES PEUVENT FAIRE EXPLOSER UN ACCUMULATEUR; L'ELECTROLYTE D'UN ACCUMU-LATEUR PEUT BRULER LA PEAU ET LES YEUX.*

*Les accumulateurs contiennent de l'électrolyte acide et dégagent des vapeurs explosives.*

1. Portez toujours un écran facial en travaillant sur un accumu-lateur.
2. Arrêtez le moteur avant de connecter ou de déconnecter des câbles d'accumulateur.
3. N'utilisez que des outils anti-étincelles pour travailler sur un accumulateur.
4. N'utilisez pas une source de courant de soudage pour charger un accumulateur ou survolter momentanément un véhicule.
5. Utilisez la polarité correcte (+ et –) de l'accumulateur.

***AVERTISSEMENT***

*LA VAPEUR ET LE LIQUIDE DE REFROIDISSEMENT BRULANT SOUS PRESSION PEUVENT BRULER LA PEAU ET LES YEUX.*

*Le liquide de refroidissement d'un radiateur peut être brûlant et sous pression.*

1. N'ôtez pas le bouchon de radiateur tant que le moteur n'est pas refroidi.
2. Mettez des gants et posez un torchon sur le bouchon pour l'ôter.
3. Laissez la pression s'échapper avant d'ôter complètement le bouchon.

## 1.05 PRINCIPALES NORMES DE SECURITE

Safety in Welding and Cutting, norme ANSI Z49.1, American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33128.

Safety and Health Standards, OSHA 29 CFR 1910, Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Recommended Safe Practices for the Preparation for Welding and Cutting of Containers That Have Held Hazardous Substances, norme AWS F4.1, American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33128.

National Electrical Code, norme 70 NFPA, National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

Safe Handling of Compressed Gases in Cylinders, document P-1, Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202.

Code for Safety in Welding and Cutting, norme CSA W117.2 Association canadienne de normalisation, Standards Sales, 276 Rexdale Boulevard, Rexdale, Ontario, Canada M9W 1R3.

Safe Practices for Occupation and Educational Eye and Face Protection, norme ANSI Z87.1, American National Standards Institute, 1430 Broadway, New York, NY 10018.

Cutting and Welding Processes, norme 51B NFPA, National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

## 1.06 LIMITED WARRANTY

LIMITED WARRANTY: Thermal Arc®, Inc., A Thermadyne Company, hereafter, “Thermal Arc” warrants to customers of itsauthorized distributors hereafter “Purchaser” that its products will be free of defects in workmanship or material. Should anyfailure to conform to this warranty appear within the time period applicable to the Thermal Arc products as stated below, Thermal Arc shall, upon notification thereof and substantiation that the product has been stored, installed, operated, and maintained in accordance with Thermal Arc’s specifications, instructions, recommendations and recognized standard industry practice, and not subject to misuse, repair, neglect, alteration, or accident, correct such defects by suitable repair or replacement, at Thermal Arc’s sole option, of any components or parts of the product determined by Thermal Arc to be defective.

THERMAL ARC MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED. THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHERS, INCLUDING, BUT NOT LIMITED TO ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

LIMITATION OF LIABILITY: THERMAL ARC SHALL NOT UNDER ANY CIRCUMSTANCES BE LIABLE FOR SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, SUCH AS, BUT NOT LIMITED TO, LOST PROFITS AND BUSINESS INTERRUPTION. The remedies of the Purchaser set forth herein are exclusive and the liability of Thermal Arc with respect to any contract, or anything done in connection therewith such as the performance or breach thereof, or from the manufacture, sale, delivery, resale, or use of any goods covered by or furnished by Thermal Arc whether arising out of contract, negligence, strict tort, or under any warranty, or otherwise, shall not, except as expressly provided herein, exceed the price of the goods upon which such liability is based. No employee, agent, or representative of Thermal Arc is authorized to change this warranty in any way or grant any other warranty.

PURCHASER’S RIGHTS UNDER THIS WARRANTY ARE VOID IF REPLACEMENT PARTS OR ACCESSORIES ARE USED WHICH IN THERMAL ARC’S SOLE JUDGEMENT MAY IMPAIR THE SAFETY OR PERFORMANCE OF ANY THERMAL ARC PRODUCT. PURCHASER’S RIGHTS UNDER THIS WARRANTY ARE VOID IF THE PRODUCT IS SOLD TO PURCHASER BY NON-AUTHORIZED PERSONS.

The warranty is effective for the time stated below beginning on the date that the authorized distributor delivers the products to the Purchaser. Notwithstanding the foregoing, in no event shall the warranty period extend more than the time stated plus one year from the date Thermal Arc delivered the product to the authorized distributor.

| **POWER SUPPLIES** | **ALL OTHER POWER SUPPLIES** | **LABOR** |
|---|---|---|
| MAIN POWER MAGNETICS (STATIC & ROTATING) | 3 YEARS | 3 YEAR |
| ORIGINAL MAIN POWER RECTIFIER | 3 YEARS | 3 YEAR |
| CONTROL PC BOARD | 3 YEARS | 3 YEAR |
| ALL OTHER CIRCUITS AND COMPONENTS INCLUDING BUT NOT LIMITED TO: CONTACTORS, RELAYS, SOLENOIDS, PUMPS, POWER SWITCHING SEMI-CONDUCTORS. | 1 YEAR | 1 YEAR |
| ENGINES: ENGINES ARE NOT WARRANTED BY THERMAL ARC, ALTHOUGH MOST ARE WARRANTED BY THE ENGINE MANUFACTURER. SEE THE ENGINE MANUFACTURE'S WARRANTY FOR DETAILS. | 1 YEAR | 1 YEAR |
| CONSOLES, CONTROL EQUIPMENT, HEAT EXCHANGES | | |
| ACCESSORY EQUIPMENT | | |

NOTE: Dragster 85® excluded from this policy. Refer to Dragster 85 warranty in Dragster 85 Owner’s Manual.

Warranty repairs or replacement claims under this limited warranty must be submitted to Thermal Arc by an authorized Thermal Arc repair facility within thirty (30) days of purchaser’s notice of any Warranty Claim. No transportation costs of any kind will be paid under this warranty. Transportation charges to send products to an authorized warranty repair facility shall be the responsibility of the Purchaser. All returned goods shall be at the Purchaser’s risk and expense. This warranty supersedes all previous Thermal Arc warranties. Thermal Arc® is a Registered Trademark of Thermadyne Industries Inc.

September 27, 2004

# SECTION 2: INTRODUCTION

## 2.01 Scope of Manual

This manual provides service instructions for the Thermal Arc® 160TS Inverter Arc Welder. Information in this edition is particularly applicable to the troubleshooting and repair of the equipment. For information on operating procedures, please refer to the 160TS Inverter Arc Welder Operating Manual (430429-505).

***NOTE***

*Service of this equipment is restricted to properly trained service technicians familiar with this equipment; unqualified personnel are strictly cautioned against attempting repairs or adjustments not covered in this manual, at the risk of voiding the warranty.*

Read both this manual and the Operating Manual thoroughly. A complete understanding of the capabilities and functions of the equipment will assure obtaining the performance for which it was designed.

***WARNING***

*There are extremely dangerous voltage and power levels present inside this unit. Do not attempt to diagnose or repair unless you have had training in high power electronics measurement and troubleshooting.*

## 2.02 General Service Philosophy

Several key points are essential to properly support the application and operation of this equipment.

### A. Application

Confirm that the equipment is capable of handling the application desired. Specifications supplied and described in Subsection 2.08 of this manual.

### B. Modifications

No physical or electrical modifications other than selection of standard options and accessories are to be made to this equipment.

### C. Customer/Operator Responsibilities

It is the customer/operator's responsibility to maintain the equipment and peripheral accessories provided by Thermal Dynamics in good operating order in accordance with the procedures outlined in the Operating Manual, and to protect the equipment from accidental or malicious damage.

### D. Repair Restrictions

The electronics consists of printed circuit board assemblies which must be carefully handled, and must be replaced as units. No replacement of printed circuit solder-mounted components is allowed except as noted in this manual.

If the Printed Circuit Board is to be returned, the replaced Printed Circuit Board Assemblies must be properly packaged in protective material and returned intact per normal procedures.

## 2.03 Service Responsibilities

The Service Technician should be familiar with the equipment and its capabilities and should be prepared to recommend arrangements of components which will provide the most efficient layout, utilizing the equipment to its best possible advantage.

Maintenance work should be accomplished in a timely manner. If problems are encountered, or the equipment does not function as specified, contact:

Thermadyne, Inc.

Thermal Arc Technical Service Department

82 Benning Street

West Lebanon, New Hampshire, USA 03784

(603) 298-5711

http://www.thermadyne.com

Additional copies of this manual may be purchased by contacting Thermal Arc at the address and phone number given in the next section. Include the Owner's Manual number and equipment identification numbers.

Electronic copies of this manual can also be downloaded at no charge in Acrobat PDF format by going to the Thermal Arc web site listed below and clicking on the Literature Library link:

http://www.thermalarc.com

## 2.04 Symbol Chart

**Note that only some of these symbols will appear on your model.**

| | |
|---|---|
| | On |
| | Off |
| | Dangerous Voltage |
| | Increase/Decrease |
| | Circuit Breaker |
| | AC Auxiliary Power |
| | Fuse |
| A | Amperage |
| V | Voltage |
| Hz | Hertz (cycles/sec) |
| f | Frequency |
| | Negative |
| | Positive |
| | Direct Current (DC) |
| | Protective Earth (Ground) |
| | Line |
| | Line Connection |
| | Auxiliary Power |
| 115V 15A | Receptacle Rating- Auxiliary Power |

| | |
|---|---|
| 1 ~ | Single Phase |
| 3 ~ | Three Phase |
| 3~ | Three Phase Static Frequency Converter-Transformer-Rectifier |
| | Remote |
| X | Duty Cycle |
| % | Percentage |
| | Panel/Local |
| | Shielded Metal Arc Welding (SMAW) |
| | Gas Metal Arc Welding (GMAW) |
| | Gas Tungsten Arc Welding (GTAW) |
| | Air Carbon Arc Cutting (CAC-A) |
| | Constant Current |
| | Constant Voltage Or Constant Potential |
| | High Temperature |
| | Fault Indication |
| | Arc Force |
| | Touch Start (GTAW) |
| | Variable Inductance |
| V | Voltage Input |

| | |
|---|---|
| | Wire Feed Function |
| | Wire Feed Towards Workpiece With Output Voltage Off. |
| | Welding Gun |
| | Purging Of Gas |
| | Continuous Weld Mode |
| | Spot Weld Mode |
| t | Spot Time |
| t1 | Preflow Time |
| t2 | Postflow Time |
| | 2 Step Trigger Operation<br>Press to initiate wirefeed and welding, release to stop. |
| | 4 Step Trigger Operation<br>Press and hold for preflow, release to start arc. Press to stop arc, and hold for preflow. |
| t | Burnback Time |
| | Disturbance In Ground System |
| IPM | Inches Per Minute |
| MPM | Meters Per Minute |
| | |
| | |

Art # A-04130

## 2.05 160TS Inverter Arc Welder Description

The Thermal Arc Model 160TS is a self contained single-phase DC arc welding power sources with Constant Current (CC) output characteristics. This unit is equipped with a Digital Volt/Amperage Meter, gas control valve, built in Sloper and Pulser, lift arc starter, and high-frequency arc starter for use with Gas Tungsten Arc Welding (GTAW), Gas Tungsten Arc Welding-Pulsed (GTAW-P) Gas Tungsten Arc Welding-Sloped (GTAW-S), and Shielded Metal Arc Welding (SMAW) processes. The power source is totally enclosed in an impact resistant, flame resistant and nonconductive plastic case.

## 2.06 Functional Block Diagrams

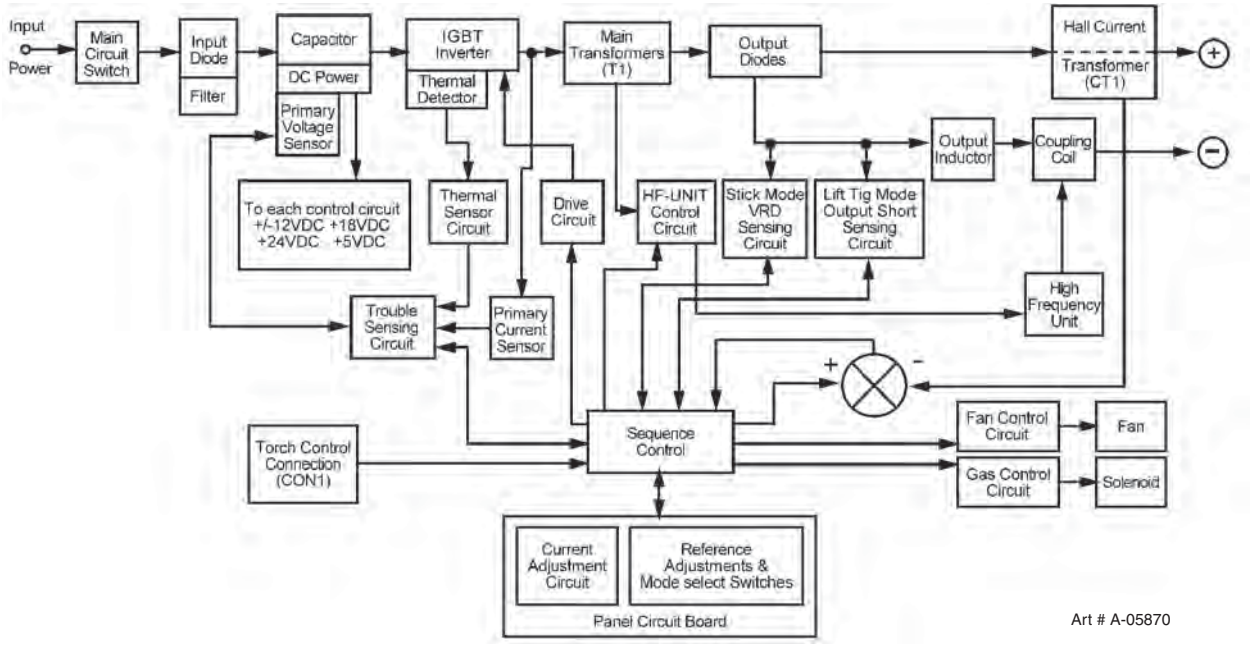



Figure 2-1: 160TS Function Block Diagram

## 2.07 Specifications

| **MODEL** | | 160TS | |
|---|---|---|---|
| **Description** | | DC STICK/LIFT TIG/HF TIG | |
| **Duty Cycle** | TIG | 160A / 16.4V @ 35% | 230VAC |
| | | 130A / 15.2V @ 60% | 230VAC |
| | | 100A / 14V @ 100% | 230VAC |
| | | 85A / 13.4V @ 100% | 115VAC |
| | STICK | 160A / 26.4V @ 35% | 230VAC |
| | | 130A / 25.2V @ 60% | 230VAC |
| | | 100A / 24V @ 100% | 230VAC |
| | | 50A / 23.4V @ 100% | 115VAC |
| **Output Current Range** | TIG | 1 – 160 (230V), 1 – 85 (115V) | |
| | STICK | 1 – 160 (230V), 1 – 85 (115V) | |
| **Open Circuit Voltage** | | 64V | |
| **Dimensions** | | | |
| Width | | 5.12” (130mm) | |
| Height | | 10.24” (260mm) | |
| Length | | 12.60” (320mm) | |
| Weight | | 18.95 lb. 8.6 kg | |
| **Output @ Rated Load** | | | |
| Rated Input Voltage | | Single Phase 115VAC | Single phase 230VAC |
| Output Amperes | | 85A | 160A |
| Output Volts | | 23.4V | 26.4V |
| Duty Cycle | | 100% | 35% |
| KVA | | 4.4 | 8.7 |
| KW | | 2.4 | 5.2 |
| **Output @ No Load** | | | |
| KVA | | 0.2 | |
| KW | | 0.1 | |
| **Input Volts Single Phase** | | **Amperage Draw @ Rated Load** | **No Load** |
| 115V | | 29 | 1.5 |
| 230V | | 34 | 1.0 |

Table 2-1: Specifications for 160TS

## 2.08 Transporting Methods

These units are equipped with a handle for carrying purposes.

***WARNING***

*ELECTRIC SHOCK can kill. DO NOT TOUCH live electrical parts. Disconnect input power conductors from de-energized supply line before moving the welding power source.*

***WARNING***

*FALLING EQUIPMENT can cause serious personal injury and equipment damage.*

Lift unit with handle on top of case.

Use handcart or similar device of adequate capacity.

If using a fork lift vehicle, place and secure unit on a proper skid before transporting.

## 2.09 Duty Cycle

The duty cycle of a welding power source is the percentage of a ten (10) minute period that it can be operated at a given output without causing overheating and damage to the unit. If the welding amperes decrease, the duty cycle increases. If the welding amperes are increased beyond the rated output, the duty cycle will decrease.

***WARNING***

*Exceeding the duty cycle ratings will cause the thermal overload protection circuit to become energized and shut down the output until the unit has cooled to normal operating temperature.*

***CAUTION***

*Continually exceeding the duty cycle ratings can cause damage to the welding power source and will void the manufactures warranty.*

***NOTE***

*Due to variations that can occur in manufactured products, claimed performance, voltages, ratings, all capacities, measurements, dimensions and weights quoted are approximate only. Achievable capacities and ratings in use and operation will depend upon correct installation, use, applications, maintenance and service.*

# SECTION 3: INSTALLATION

## 3.01 Environment

The P-Wee 160TS is designed for use in adverse environments.

Examples of environments with increased adverse conditions are:

a. In locations in which freedom of movement is restricted, so that the operator is forced to perform the work in a cramped (kneeling, sitting or lying) position with physical contact with conductive parts;

b. In locations which are fully or partially limited by conductive elements, and in which there is a high risk of unavoidable or accidental contact by the operator, or

c. In wet or damp hot locations where humidity or perspiration considerably reduces the skin resistance of the human body and the insulation properties of accessories.

Environments with adverse conditions do not include places where electrically conductive parts are in the near vicinity of the operator, which can cause increased hazard, but have been insulated.

## 3.02 Location

Be sure to locate the welder according to the following guidelines:

- In areas, free from moisture and dust. · Ambient temperature between 0 degrees C to 40 degrees C.
- In areas, free from oil, steam and corrosive gases.
- In areas, not subjected to abnormal vibration or shock.
- In areas, not exposed to direct sunlight or rain.
- Place at a distance of 12" (304.79mm) or more from walls or similar that could restrict natural airflow for cooling.

***WARNING***

*Thermal Arc advises that this equipment be electrically connected by a qualified electrician.*

## 3.03 Electrical Input Connections

***WARNING***

*ELECTRIC SHOCK can kill; SIGNIFICANT DC VOLTAGE is present after removal of input power.*

DO NOT TOUCH live electrical parts.

SHUT DOWN welding power source, disconnect input power employing lockout/tagging procedures. Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

## 3.04 Electrical Input Requirements

Operate the welding power source from a single-phase 50/60 Hz, AC power supply. The input voltage must match one of the electrical input voltages shown on the input data label on the unit nameplate. Contact the local electric utility for information about the type of electrical service available, how proper connections should be made, and inspection required.

The line disconnect switch provides a safe and convenient means to completely remove all electrical power from the welding power supply whenever necessary to inspect or service the unit.

***Note***

*These units are equipped with a two-conductor with earth power cable that is connected at the welding power source end for single phase electrical input power.*

Do not connect an input (WHITE or BLACK) conductor to the ground terminal.

Do not connect the ground (GREEN) conductor to an input line terminal.

Refer to Figure 3-1 and:

1. Connect end of ground (GREEN) conductor to a suitable ground. Use a grounding method that complies with all applicable electrical codes.
2. Connect ends of line 1 (BLACK) and line 2 (WHITE) input conductors to a de-energized line disconnect switch.
3. Use Table 3-1 and Table 3-2 as a guide to select line fuses for the disconnect switch.

| Input Voltage | Fuse Size |
|---|---|
| 115 VAC | 40 Amps |
| 208/230 VAC | 45 Amps |

Table 3-1: Electrical Input Connections

***Note***

*Fuse size is based on not more than 200 percent of the rated input amperage of the welding power source (Based on Article 630, National Electrical Code).*

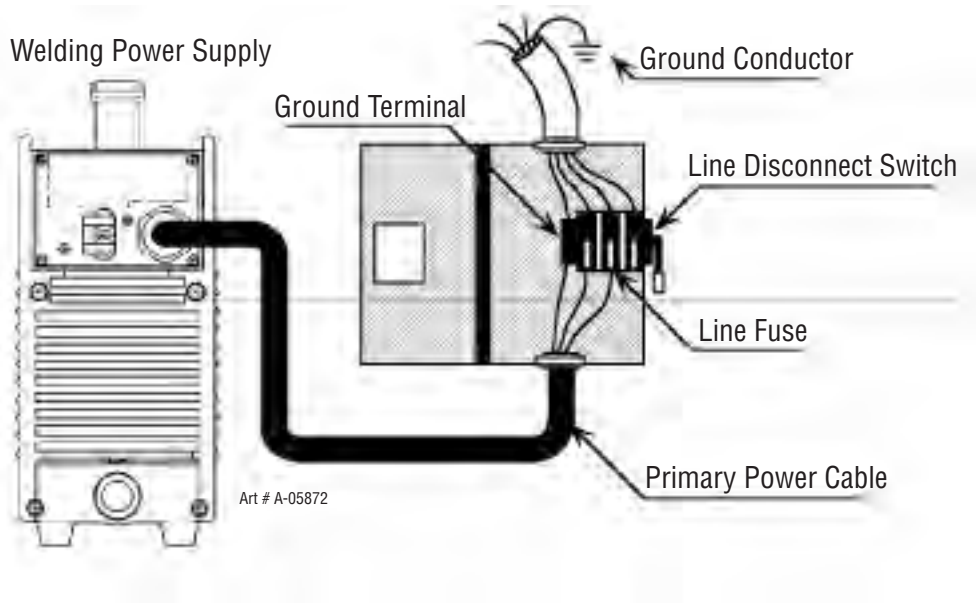



Figure 3-1: Electrical Input Connections

Each unit incorporates an INRUSH circuit and input voltage sensing circuit. When the MAIN CIRCUIT SWITCH is turned on, the inrush circuit provides a pre-charging of the input capacitors. SCR's in the Power Control Assembly (PCA) will turn on after the input capacitors have charged to full operating voltage (after approximately 5 seconds).

***Note***

*Note the available input power. Damage to the PCA could occur if 460VAC or higher is applied.*

The following 115/230V Primary Current recommendations are required to obtain the maximum welding current and duty cycle from this welding equipment:

| Model | Primary Supply Lead Size (Factory Fitted) | Minimum Primary Current Circuit Size (Vin/Amps) | Current & Duty Cycle | |
|---|---|---|---|---|
| | | | TIG | STICK |
| P-Wee 160TS | 12/3 AWG minimum | 115/22 | 85A @ 100% | - |
| | | 208/25 | 160A @ 35% | - |
| | | 230/23 | | - |
| | | 115/38 | - | 85A @ 100% |
| | | 208/42 | - | 160A @ 35% |
| | | 230/38 | - | |

Table 3-2: 115/230V Primary Current Circuit sizes to achieve maximum current.

## 3.05 High Frequency Introduction

The importance of correct installation of high frequency welding equipment cannot be overemphasized. Interference due to high frequency initiated or stabilized arc is almost invariably traced to improper installation. The following information is intended as a guide for personnel installing high frequency welding machines.

***WARNING EXPLOSIVES***

*The high frequency section of this machine has an output similar to a radio transmitter. The machine should NOT be used in the vicinity of blasting operations due to the danger of premature firing.*

***WARNING COMPUTERS***

*It is also possible that operation close to computer installations may cause computer malfunction.*

## 3.06 High Frequency Interference

Interference may be transmitted by a high frequency initiated or stabilized arc welding machine in the following ways:

### Direct Radiation

Radiation from the machine can occur if the case is metal and is not properly grounded. It can occur through apertures such as open access panels. The shielding of the high frequency unit in the Power Source will prevent direct radiation if the equipment is properly grounded.

### Transmission via the Supply Lead

Without adequate shielding and filtering, high frequency energy may be fed to the wiring within the installation (mains) by direct coupling. The energy is then transmitted by both radiation and conduction. Adequate shielding and filtering is provided in the Power Source.

### Radiation from Welding Leads

Radiated interference from welding leads, although pronounced in the vicinity of the leads, diminishes rapidly with distance. Keeping leads as short as possible will minimize this type of interference. Looping and suspending of leads should be avoided where possible.

### Reradiation from Unearthed Metallic Objects

A major factor contributing to interference is reradiation from unearthed metallic objects close to the welding leads. Effective grounding of such objects will prevent reradiation in most cases.

# SECTION 4:
# OPERATION

## 4.01 Controls

See Figure 4-1

### 1. Control Knob

This control sets the selected weld parameter, rotating it clockwise increases the parameter and is indicated on the digital meter. Pushing the knob inward displays the actual welding voltage.

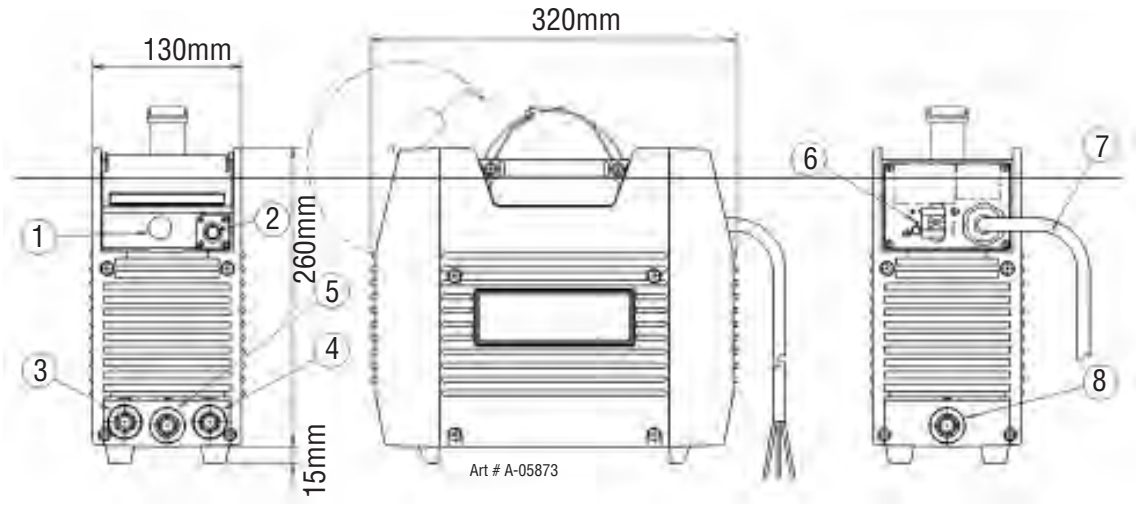



Figure 4-1: P-Wee 160TS Power Source

### 2. Remote Control Socket

The 8 pin Remote Control Socket is used to connect remote current control devices to the welding Power Source. To make connections, align keyway, insert plug, and rotate threaded collar fully clockwise.

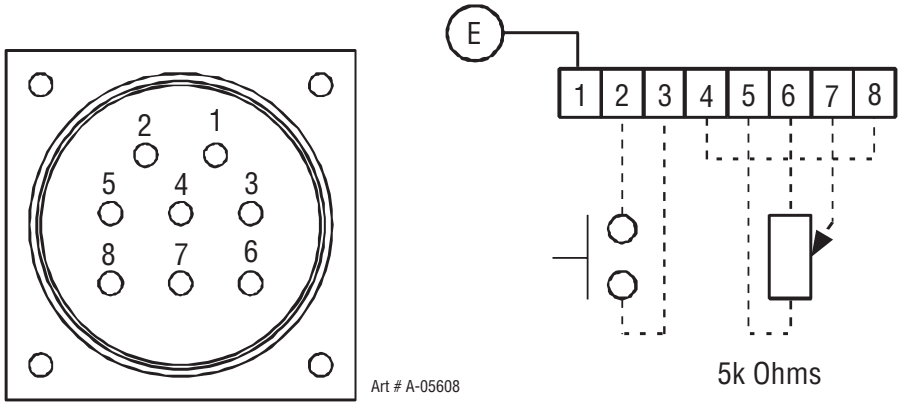



Figure 4-2: Front view of 8-Socket Receptacle

| Socket Pin | Function |
|---|---|
| 1 | Mains Earth |
| 2 | Torch Switch Input (24V) to energise weld current. (connect pins 2 & 3 to turn on welding current) |
| 3 | Torch Switch Input (0V) to energise weld current (connect pins 2 & 3 to turn on welding current) |
| 4 | Connect pin 4 to pin 8 to instruct machine that a remote control device is connected (12V DC supply) |
| 5 | 5k ohm (maximum) connection to 5k ohm remote control potentiometer |
| 6 | Zero ohm (minimum) connection to 5k ohm remote control potentiometer |
| 7 | Wiper arm connection to 5k ohm remote control potentiometer |
| 8 | Connect pin 4 to pin 8 to instruct machine that a remote control device is connected (0V) |

Table 4-1: 8-Socket Pin Descriptions

### 3. Positive Terminal

Welding current flows from the Power Source via heavy duty Dinse type terminal. It is essential, however, that the male plug is inserted and turned securely to achieve a sound electrical connection.

### 4. Negative Terminal

Welding current flows from the Power Source via heavy duty Dinse type terminal. It is essential, however, that the male plug is inserted and turned securely to achieve a sound electrical connection.

***CAUTION***

*Loose welding terminal connections can cause overheating and result in the male plug being fused in the bayonet terminal.*

### 5. Gas Outlet

The Gas Outlet is a 5/8 18 UNF female gas fitting.

### 6. ON/OFF Switch

This switch connects the Primary supply voltage to the inverter when in the ON position. This enables the Power Supply.

***WARNING***

*When the welder is connected to the Primary supply voltage, the internal electrical components maybe at 240V potential with respect to earth.*

### 7. Input Cable

The input cable connects the Primary supply voltage to the equipment.

### 8. Gas Inlet

The Gas Inlet is a 5/8 18 UNF female gas fitting.

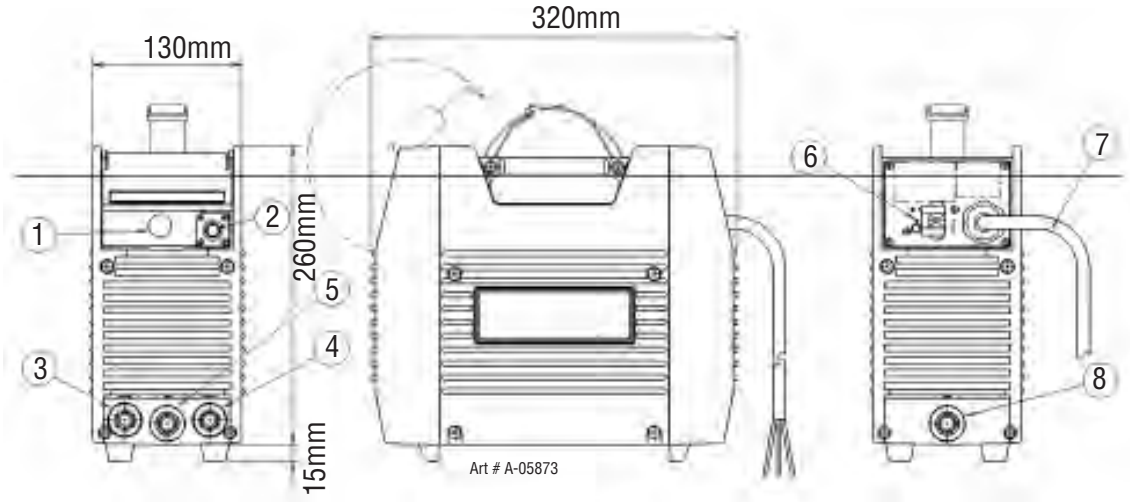



Figure 4-1: P-Wee 160TS Power Supply

## 4.02 Weld Parameters and Descriptions

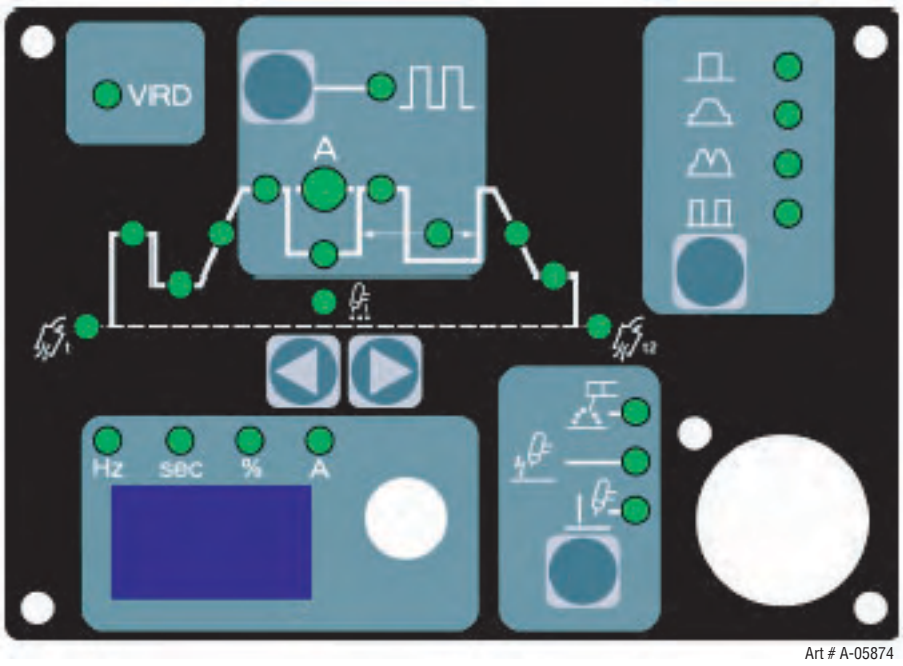



Figure 4-3: Front Panel

| Parameter | Description |
|---|---|
| *PRE-FLOW* | This parameter operates in TIG modes only and is used to get gas to the weld zone prior to striking the arc, once the torch trigger switch has been pressed. This control is used to dramatically reduce weld porosity at the start of a weld. |
| *HOT START* | This parameter operates in all weld modes except Lift TIG mode and is used to heat up the weld zone in TIG modes or improve the start characteristics for stick electrodes. e.g. low hydrogen electrodes. It sets the peak start current on top of the *BASE (WELD)* current. e.g. *HOT START* current = 130 amps when *BASE (WELD)* = 100 amps & *HOT START* = 30 amps |
| *INITIAL CUR.* | This parameter operates in *SLOPE* or *REPEAT* (4T) TIG modes only and is used to set the start current for TIG. The Start Current remains on until the torch trigger switch is released after it has been depressed. |
| *UP SLOPE* | This parameter operates in TIG modes only and is used to set the time for the weld current to ramp up, after the torch trigger switch has been pressed then released, from INITIAL CUR to PEAK or BASE current |
| *PEAK CUR.* | This parameter sets the PEAK weld current when in *PULSE* mode |
| *WELD* | This parameter sets the TIG WELD current in *STD*, *SLOPE*, *REPEAT* and *SPOT* modes when *PULSE* is off. This parameter also sets the STICK weld current. |
| *BASE (Background Current)* | This parameter sets the Background current when in Pulse TIG mode. |
| *SPOT TIME* | This parameter sets the duration of the *SPOT TIME* in *HF TIG* mode only |

Table 4-2a: Weld Parameter Descriptions

| Parameter | Description |
|---|---|
| *PULSE WIDTH* | This parameter sets the percentage on time of the *PULSE FREQUENCY* for PEAK weld current when the *PULSE* is on. |
| *PULSE FREQ.* | This parameter sets the *PULSE FREQUENCY* when the *PULSE* is on. |
| *DOWN SLOPE* | This parameter operates in TIG modes only and is used to set the time for the weld current to ramp down, after the torch trigger switch has been pressed, to *CRATER CUR.* This control is used to eliminate the crater that can form at the completion of a weld. |
| *CRATER CUR.* | This parameter operates in *SLOPE* or *REPEAT* (4T) TIG modes only and is used to set the finish current for TIG. The CRATER Current remains on until the torch trigger switch is released after it has been depressed. |
| *POST-FLOW* | This parameter operates in TIG modes only and is used to adjust the post gas flow time once the arc has extinguished. This control is used to dramatically reduce oxidation of the tungsten electrode. |

Table 4-2b: Weld Parameter Descriptions Continued.

## 4.03 Weld Parameters

| Weld Parameter | Parameter Range | Factory Setting | Incremental Unit | Weld Mode | | |
|---|---|---|---|---|---|---|
| | | | | STICK | HF TIG | LIFT TIG |
| Pre-Flow | 0.0 to 1.0 sec | 0.1 sec | 0.1 sec | No | Yes | Yes |
| Hot Start | 0 to 70A | 20A | 1 A | Yes | Yes | No |
| Initial Cur. | 1 to 160A | 30A | 1 A | No | Yes | Yes |
| Up Slope | 0 to 15 sec | 1 sec | 0.1 sec | No | Yes | Yes |
| Peak Cur. | 1 to 160A | 120A | 1 A | No | Yes | Yes |
| Weld Cur | 1 to 160A 230V | 80A | 1 A | No | Yes | Yes |
| TIG | 1 to 85A 115V | 80A | 1 A | No | Yes | Yes |
| Weld Cur | 1 to 160A 230V | 80A | 1 A | Yes | No | No |
| Stick | 1 to 85A 115V | 80A | 1 A | Yes | No | No |
| Spot Time | 0.5 to 5.0 sec | 2 sec | 0.1 sec | No | Yes | No |
| Pulse Width | 15 to 80% | 50% | 1 % | No | Yes | Yes |
| Pulse Freq | 0.5 to 500Hz | 100.0Hz | see Table 4-4 | No | Yes | Yes |
| Down Slope | 0 to 25 sec | 3 sec | 0.1 sec | No | Yes | Yes |
| Crater Cur. | 1 to 160A | 30A | 1 A | No | Yes | Yes |
| Post-Flow | 0.0 to 60 sec | 10 sec | 0.1 sec | No | Yes | Yes |

Table 4-3: Weld Parameters

| PULSE FREQ. Range | Incremental Unit |
|---|---|
| 0.5 to 20Hz | 0.1Hz |
| 20 to 100Hz | 1Hz |
| 100 to 500Hz | 5Hz |

Table 4-4: Pulse Frequency Range and Incremental Units

## 4.04 Weld Process selection

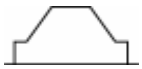
| Weld Process Selection | Weld Mode | | | Description |
|---|---|---|---|---|
| | STICK | HF TIG | LIFT TIG | |
| STD | YES | YES | YES | 2T operatoin in TIG Modes using remote devices to control contactor and current |
| Slope  | NO | YES | YES | 4T Operation in TIG Modes with crater fill using remote devices to control contactor and current |
| Repeat | NO | YES | YES | 4T operation in TIG Modes with repeat operation and crater fill using a remote contactor device |
| Spot | NO | YES | NO | 2T operation spot welding in HF TIG a remote contactor device |
| Pulse ON/OFF | NO | YES | YES | Pulse Operation in TIG Modes |

Table 4-5: Weld Process selection verses Weld Mode

## 4.05 Power Source Features

| Feature | Description |
|---|---|
| **New Digital Control** | A Almost all welding parameters are adjustable |
| **Touch Panel Switches** | A Touch switches eliminate mechanical damage |
| **Front Control Cover** | A Protects front panel controls |
| **Digital Meter** | A Displays selected weld parameter value |
| | B Displays average weld current when welding |
| | C Displays weld current for 20 seconds after weld has been completed |
| | D A selected weld parameter value can be adjusted at any time even while welding |
| **ON/OFFswitch** | A Mains ON/OFF switch located on rear panel |
| **Voltage Reduction Device (VRD)** | Reduces the OCV when the power supply is not in use. Eliminates the need for add on voltage reducers and has no effect on arc starting. |
| | A VRD fully complies to IEC 60974-1 |
| | B With Stick mode selected, the green VRD light is ON when not welding and red when welding. |
| | C When in TIG modes VRD is off |
| **Control Knob** | A For the selected weld parameter, rotating the knob clockwise increases the parameter |
| | B Rotating the knob anti-clockwise decrease the parameter |
| | C A selected weld parameter value can be adjusted at any time even while welding |
| | D Pushing the knob in displays actual arc voltage |
| **Self Diagnosis Using Error Codes** | A An error code is displayed on the *Digital Meter* when a problem occurs with Mains supply voltage or internal component problems. Refer to service section 5 |

Table 4-6: Power Source Features

## 4.06 General Set-Up

Conventional operating procedures apply when using the Welding Power Source, i.e. connect work lead directly to work piece and electrode lead is used to hold electrode. Wide safety margins provided by the coil design ensure that the Welding Power Source will withstand short-term overload without adverse effects. The welding current range values should be used as a guide only. Current delivered to the arc is dependent on the welding arc voltage, and as welding arc voltage varies between different classes of electrodes, welding current at any one setting would vary according to the type of electrode in use. The operator should use the welding current range values as a guide, then finally adjust the current setting to suit the application.

***WARNING***

*Before connecting the work clamp to the work and inserting the electrode in the electrode holder make sure the Primary power supply is switched off.*

***CAUTION***

*Remove any packaging material prior to use. Do not block the air vents at the front or rear or sides of the Welding Power Source.*

***CAUTION***

*DO NOT change the Weld Mode or Weld Process Mode until after POST-FLOW time has finished.*

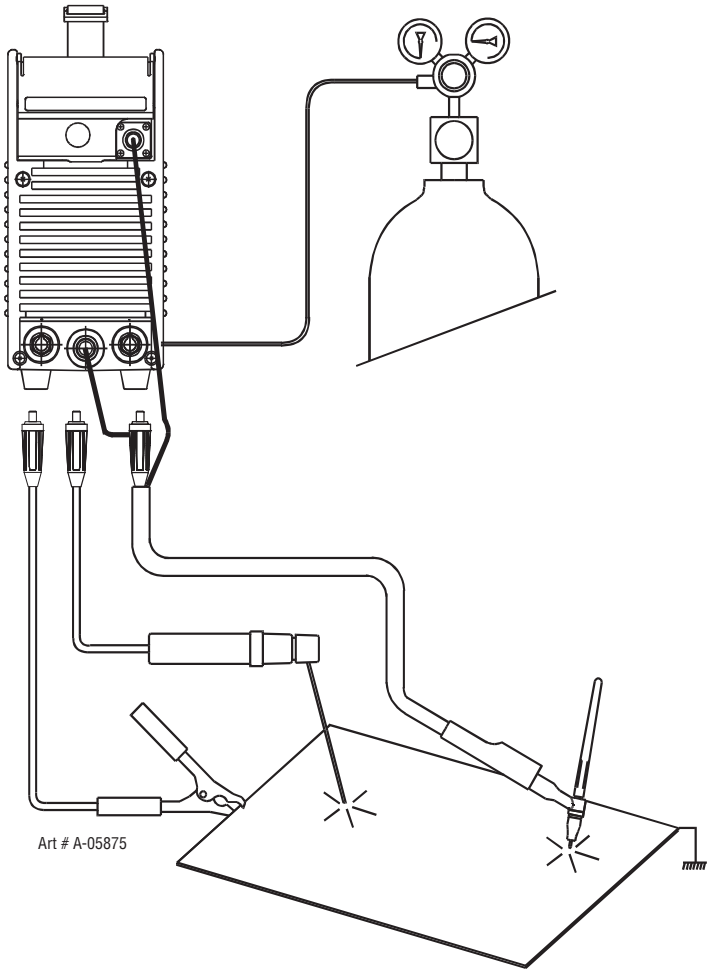



Figure 4-4: 160TS Setup

## 4.07 SEQUENCE OF OPERATION

**1. Pulse function:**

Pressing this button enables the TIG current pulse functions.

**2. Scroll Buttons:**

Used to select the parameter to be set. The LED's show which function is being adjusted on the weld sequence graph.

***NOTE***

*Scroll Buttons are used to select the parameters to be set. The LED's show which function is being adjusted on the weld sequence graph. Refer to Symbols Table located in the front of the manual for Symbol descriptions.*

**3. Digital LED display:**

Welding amperage and parameter values are displayed in this window. Internal warnings such as over temperature, low or high input voltage applied are signaled to the operator by a warning sound and error message on the screen.

**4. Control knob:**

Allows the operator to adjust the output amperage within the entire range of the power source, also used to set each parameter value. Pushing the knob inward displays the actual welding voltage.

**5. Process Button:**

This button selects between STICK, Lift or HF TIG mode.

**6. 8 pin remote control receptacle:**

Used for connecting remote device. A remote control device is required for use during LIFT TIG and HF TIG operation. See section 4.01, page 4-2 "*Remote Control Socket*", for complete details of the remote device.

**7. TIG Mode Functions:**

Pressing this button scrolls through the output TIG function modes (Standard, Slope, Slope w/repeat, Spot).

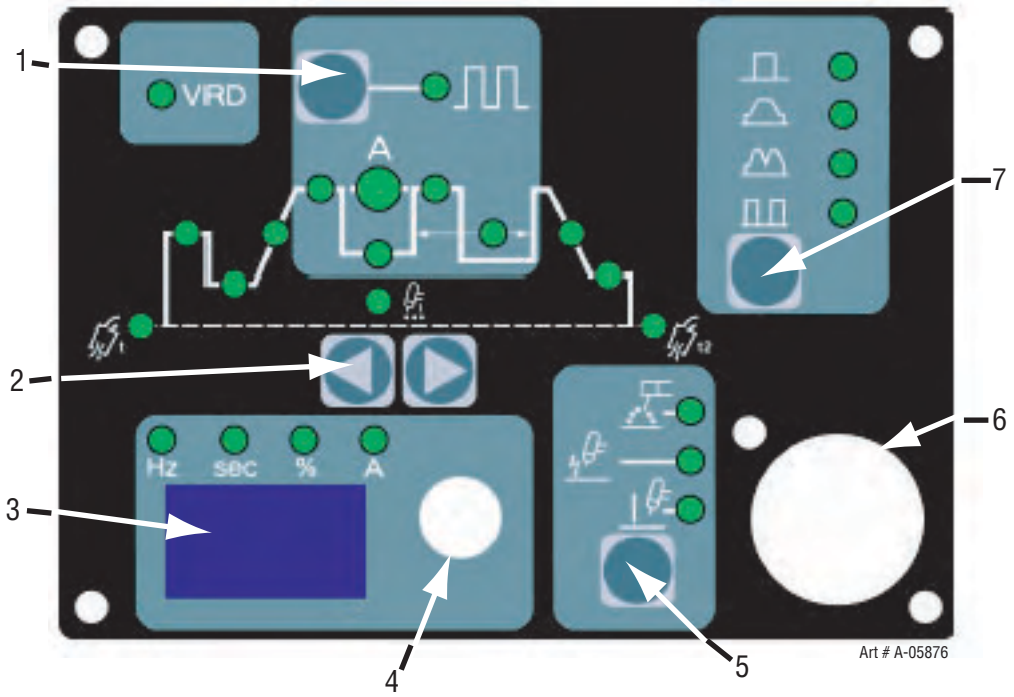



Figure 4-5: 160TS Front Panel Button Descriptions

## 4.08 Stick Welding Setup

1. Connect work lead to negative terminal
2. Connect electrode lead to positive terminal
3. Switch machine on
4. Set weld current
5. Connect remote control device if required
6. Use the Scroll Buttons to move to the parameter to be set. The LED will show which function is being adjusted on the weld sequence graph. Use the control knob to adjust each parameter.
7. Set HOT START
8. Set WELD current
9. Commence welding

## 4.09 HF TIG & Lift TIG Welding Setup

1. Connect work lead to positive terminal
2. Connect TIG torch to negative terminal
3. Switch machine on
4. Set weld current.
5. Connect remote control device. A remote control device is required for use during LIFT TIG and HF TIG operation. See section 4.01, page 4-2 “Remote Control Socket”, for complete details of the remote device.
6. Use the Scroll Buttons to move to the parameter to be set. The LED will show which function is being adjusted on the weld sequence graph. Use the control knob to adjust each parameter.
7. Set PRE-FLOW time
8. Set HOT START current
9. Set POST-FLOW time
10. Set WELD current
11. Set POST-FLOW time

**Slope Mode Parameters if required**

12. Set INITIAL CUR current
13. Set UP SLOPE time
14. Set (WELD) PEAK CUR current
15. Set BASE current
16. Set DOWN SLOPE time
17. Set CRATER CUR current

**Pulse Mode parameters if required**

18. Set PULSE WIDTH % for PEAK CURRENT
19. Set PEAK CURRENT
20. Set PULSE FREQ
21. Commence welding

## 4.10 Slope Mode Sequence Description

***NOTE***

*Slope function operates with a Remote ON/ OFF device only.*

**1. To start Slope sequence:**

Close remote switch contacts. Once the welding arc is established the Power Source will maintain initial current setting as long as the remote switch contacts are closed.

a) In the HF TIG mode, after Preflow time High Frequency is present at the torch. When the torch is positioned close to the work the welding current will transfer to the work and establish the arc at the initial current setting.

b) In the Lift TIG mode, after preflow time Lift Start current is present at the torch. When the electrode is touched to the work and lifted off, the welding arc is established at the initial current setting.

**2. Open Remote Switch:**

Current increases to weld current. Once welding arc has reached weld current the power source will maintain weld current as long as the remote switch contacts are open.

**3. Close Remote Switch:**

Welding current decreases to final current setting. Once final welding current is reached the power source will maintain final current setting as long as the remote switch contacts are closed.

**4. Open Remote Switch:**

Welding arc stops and post flow begins.

**Slope Mode with repeat sequence**

The repeat function is operated during the down slope cycle of the Slope Sequence and is active through the down slope period only. During the down slope period by opening the Remote Switch contacts the current will increase back to weld current. Within the Down Slope period the repeat function can operated as many times as desired. To continue slope cycle and end slope sequence close remote switch contacts and allow weld current to reach final current setting. Once final current setting is reached opening the Remote Switch again will turn off the welding arc and post flow begins.

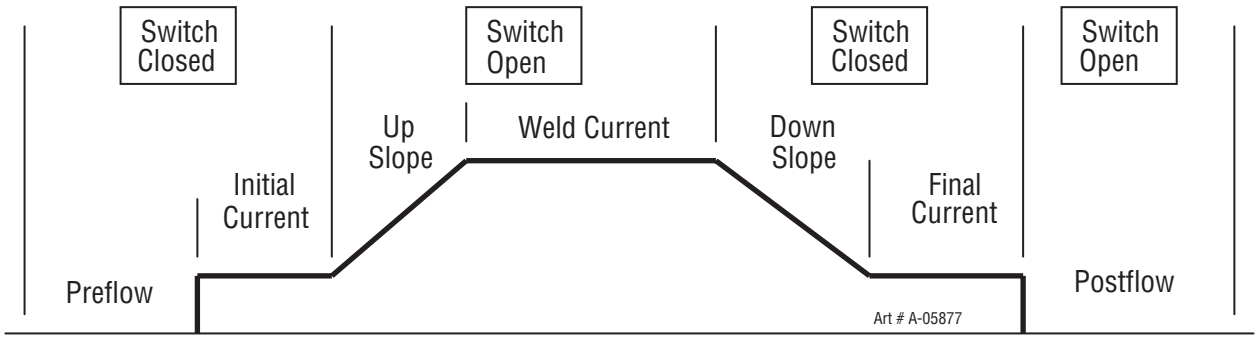



Figure 4-6: Slope Mode Description

## 4.11 Pulse Controls

The Pulse controls are used primarily to control heat input. Pulse offers a number of advantages as follows:

1. Control puddle – size and fluidity (especially out of position).
2. Increase penetration
3. Travel speed control
4. Better consistent quality
5. Distortion on lighter or thinner materials.

Pulse-current provides a system in which the welding current continuously changes between two levels. During the periods of Peak current heating and fusion takes place and during the background (base) current periods, cooling and solidification take place. Pulse Width is the time in one cycle the current stays at the peak current setting. Pulse Frequency measured in Hertz is the number of cycles per second the current travels between peak and background current settings. It is as if the foot rheostat were moved up and down to increase and decrease the welding current on a regular basis. The faster you moved the foot rheostat up and down the faster the frequency.

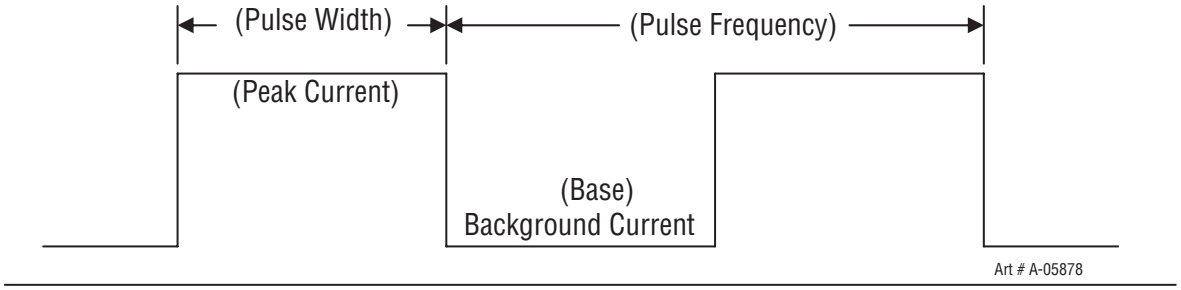



Figure 4-7: Pulse Control Sequence

## 4.12 Switching VRD On/Off

Switch the machine Off.

a) Remove the controls clear cover (see Figure 4-8)

- Lift up the cover so it rests on the top of the unit
- Place a small flat bladed screw driver between the cover hinge on the front panel
- Gently lift the cover hinge out of the front cover mounting hole
- Remove the controls clear cover

Figure 4-8: VRD ON/OFF step a

b) Remove the controls mounting screws (see Figure 4-9)

- Remove the four controls mounting screws

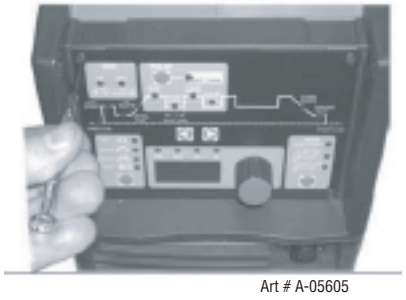



Figure 4-9: VRD ON/OFF step b

c) Access the VRD control (see Figure 4-10)

- Gently pry back the front panel controls to access the VRD on/off switch.

***Caution***

*DO NOT pull back the front panel with excessive force as this will unplug control PCB. Plugging the control PCB back into the front panel controls can only be achieved by removing the side covers.*

Figure 4-10: VRD ON/OFF step c

d) Turning the VRD ON/OFF (see Figure 4-11)

- To turn VRD ON: rotate the trim potentiometer on the display PCB fully clockwise. When VRD is turned ON check that it operates as per VRD Specifications in Table 5-4 page 5-7.
- To turn VRD OFF: rotate the trim potentiometer on the display PCB fully counter clockwise.

***WARNING***

*The VRD ON/OFF trim potentiometer MUST ONLY be positioned fully clockwise OR fully counter clockwise as the VRD function will be unknown for every other position.*

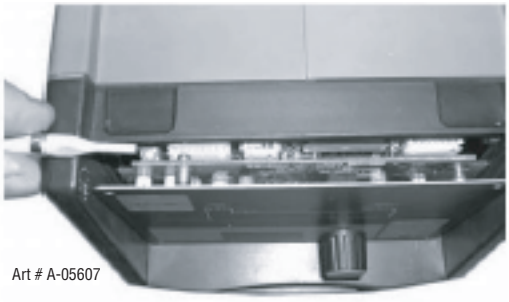



Figure 4-11: VRD ON/OFF step d

## 4.13 SEQUENCE TIMING DIAGRAMS

### STICK Mode

#### STICK with VRD DISABLED (Voltage Reduction Device)

Figure 4-12 shows the STICK timing waveforms with the VRD control DISABLED. Placing Pin2 of DSW1 on PCB5 (WK-4986) in the OFF position to turn off the VRD.

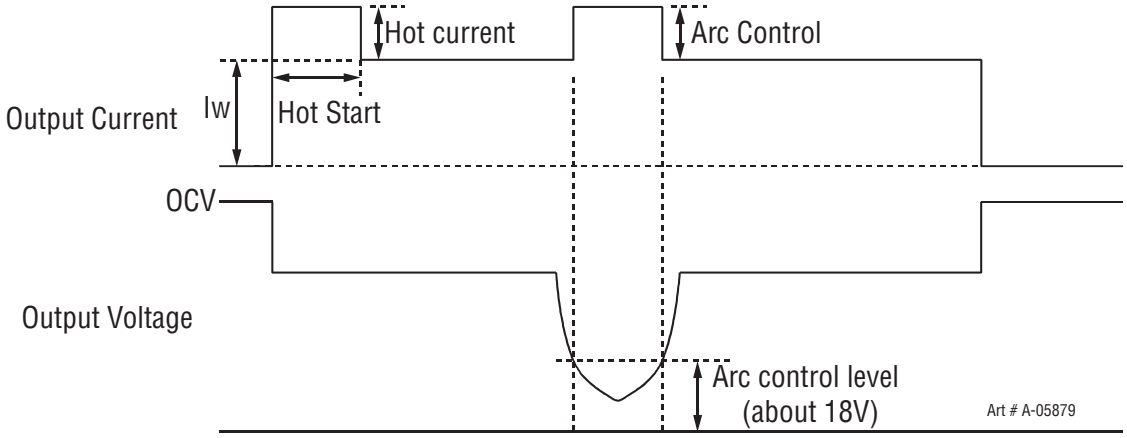



Figure 4-12: STICK mode timing with the VRD disabled.

#### STICK with VRD ENABLED (Voltage Reduction Device)

Figure 4-13 shows the STICK timing waveforms with the VRD function OFF. If place Pin2 at DSW1 on PCB5 (WK-4986) in ON position to turn on the VRD.

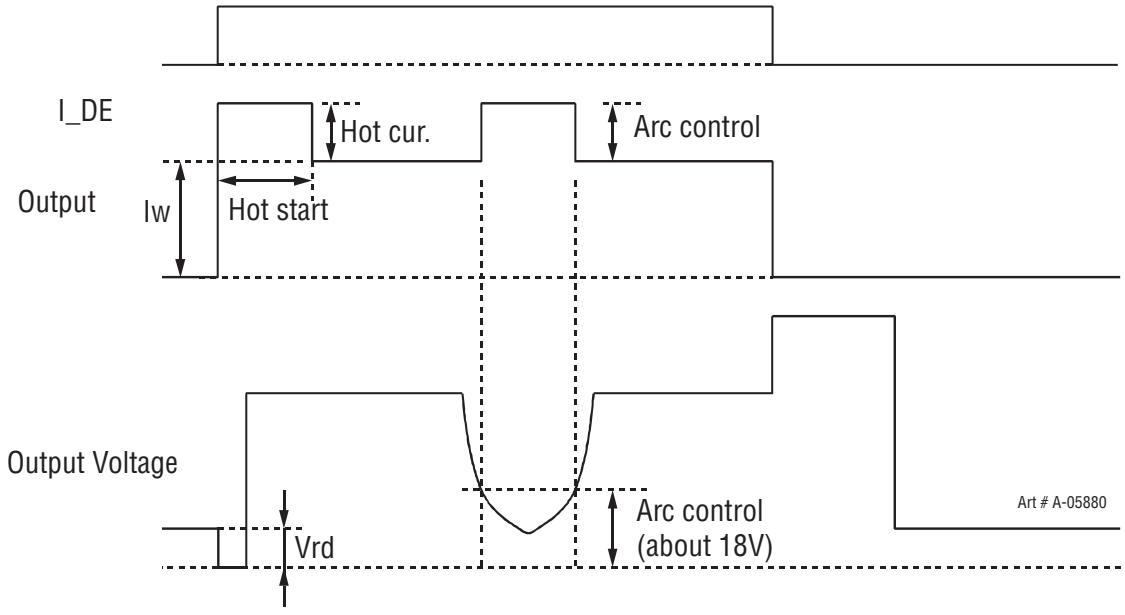



Figure 4-13: STICK mode timing with the VRD enabled.

## LIFT TIG Mode

### LIFT TIG STD Mode

Figure 4-14 shows the LIFT TIG STD timing waveforms with PULSE control ON and OFF.

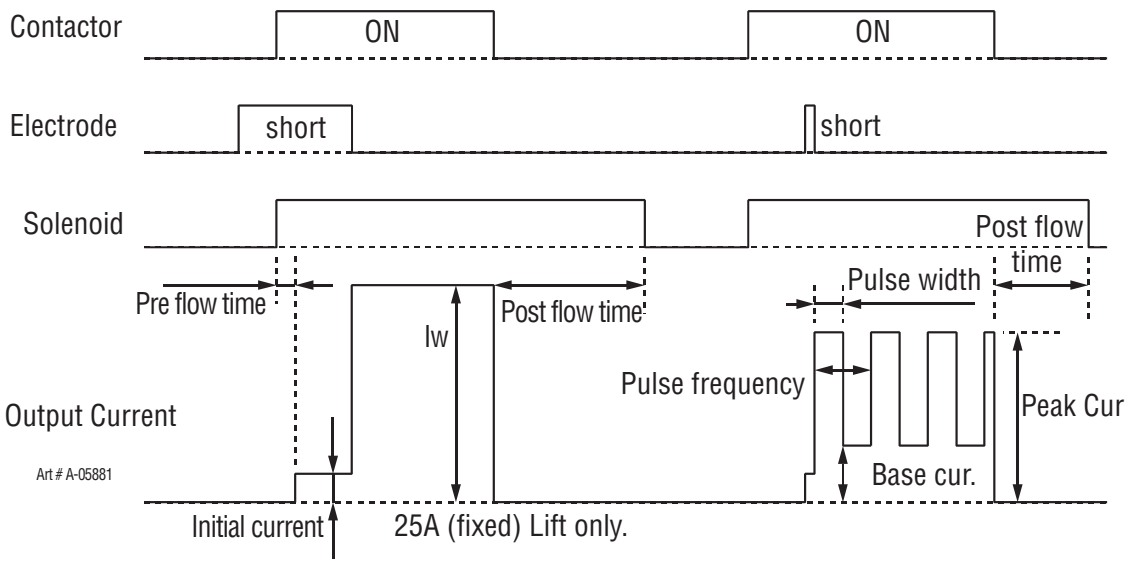



Figure 4-14: LIFT TIG STD mode timing.

### LIFT TIG SLOPE Mode

Figure 4-15 shows the LIFT TIG SLOPE timing waveforms with PULSE control ON and OFF.

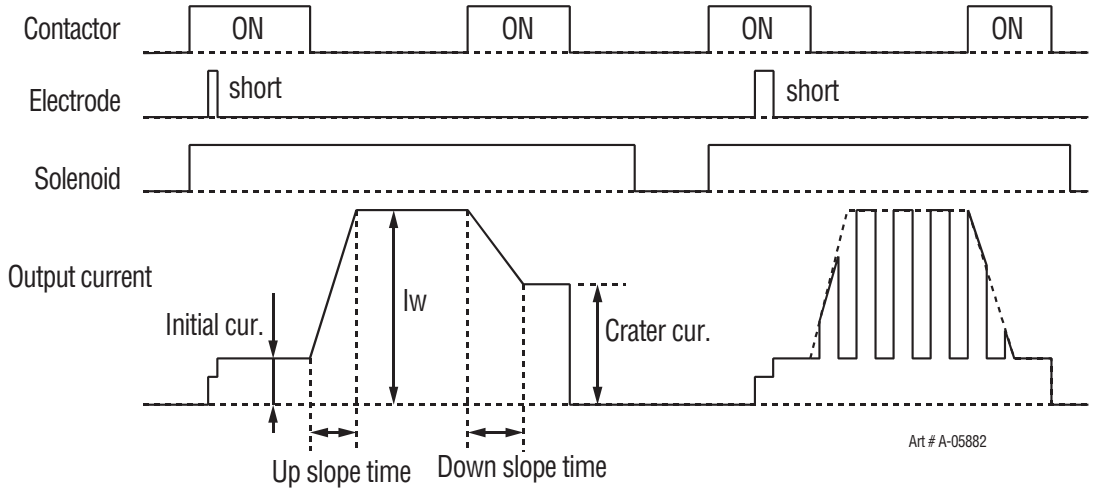



Figure 4-15: LIFT TIG SLOPE mode timing.

### LIFT TIG REPEAT Mode

Figure 4-16 shows the LIFT TIG REPEAT timing waveforms with PULSE control ON and OFF.

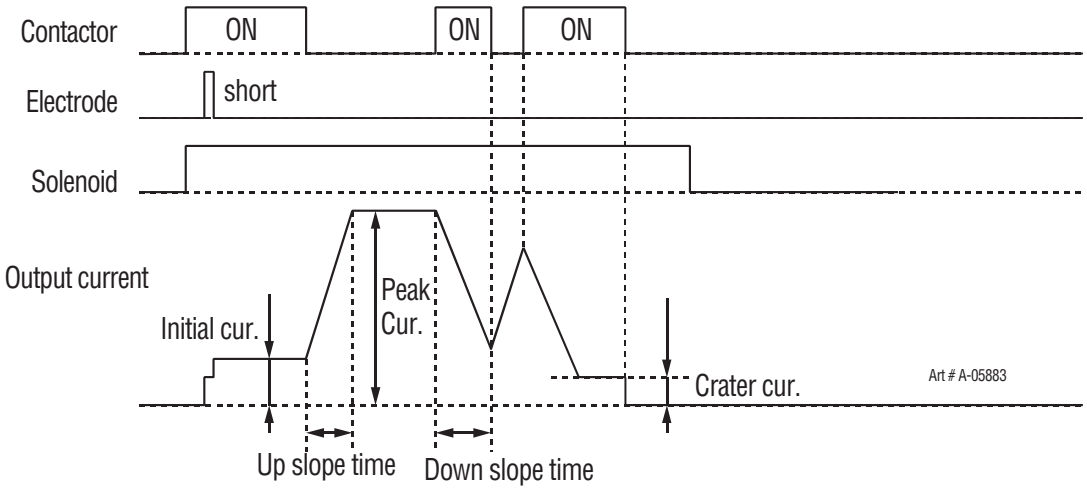



Figure 4-16: LIFT TIG REPEAT mode timing.

## HF TIG Mode

### HF TIG STD Mode

Figure 4-17 shows the HF TIG STD timing waveforms with PULSE control ON and OFF.

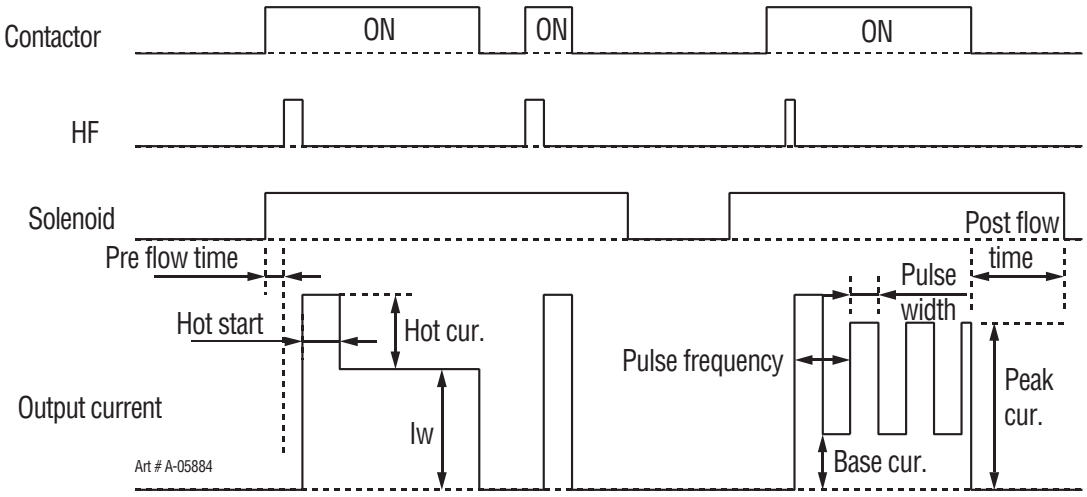



Figure 4-17: HF TIG STD mode timing

### HF TIG SLOPE Mode

Figure 4-18 shows the HF TIG SLOPE timing waveforms with PULSE control ON and OFF.

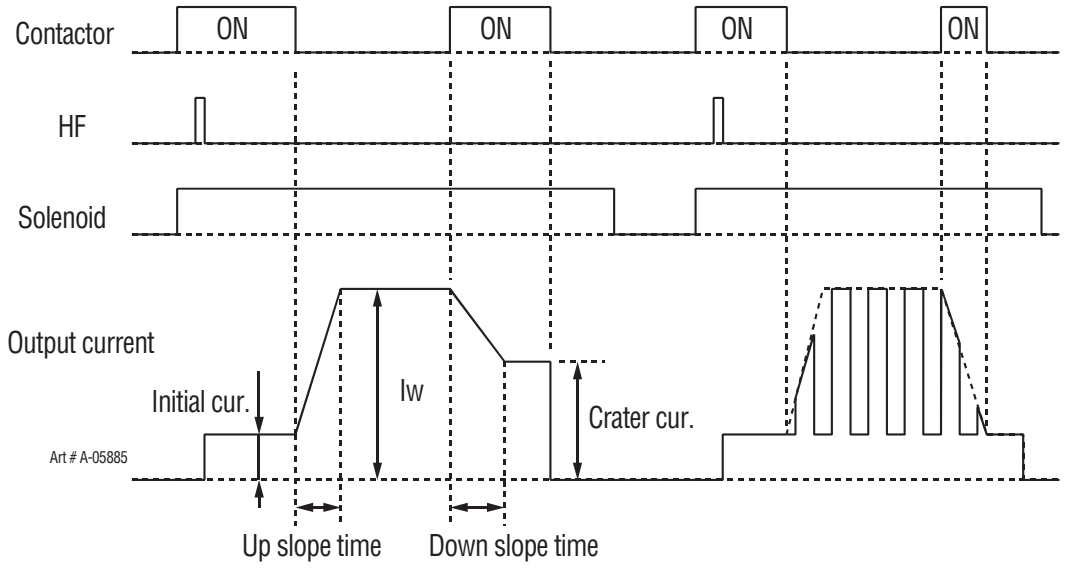



Figure 4-18: HF TIG SLOPE mode timing.

### HF TIG REPEAT Mode

Figure 4-19 shows the HF TIG REPEAT timing waveforms with PULSE control ON and OFF.

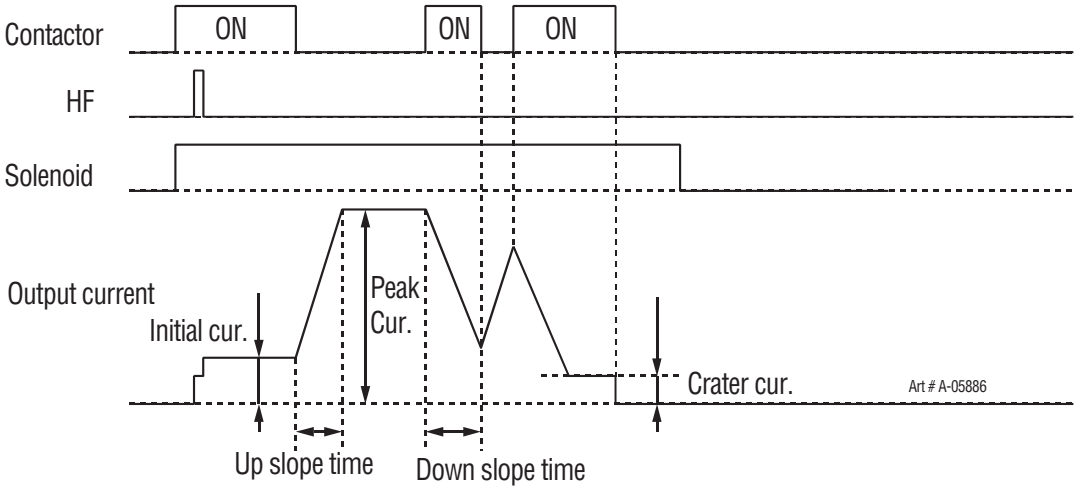



Figure 4-19: HF TIG REPEAT mode timing.

### HF TIG SPOT Mode

Figure 4-20 shows the HF TIG SPOT timing waveforms with PULSE control ON and OFF.

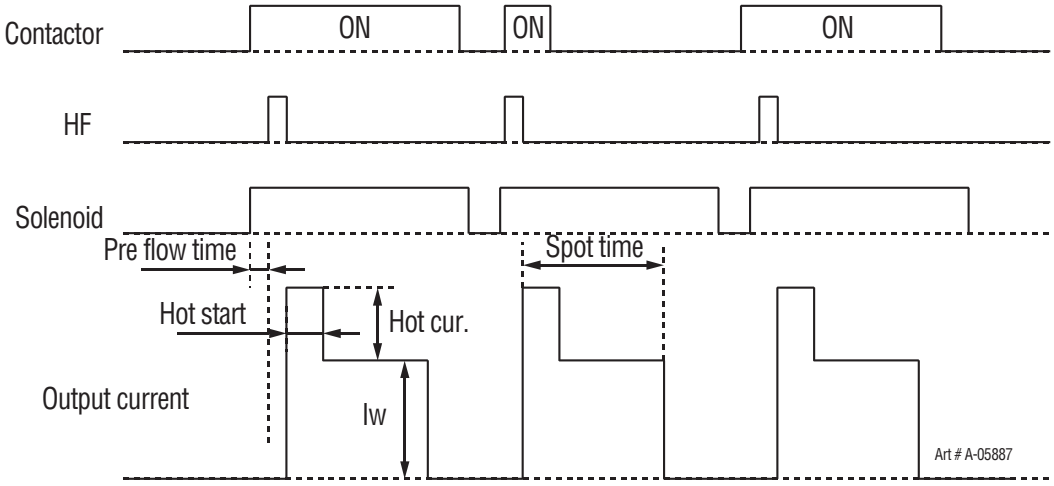



Figure 4-20: HF TIG SPOT mode timing.

# SECTION 5: SERVICE

## 5.01 Routine Maintenance

The only routine maintenance required for the power supply is a thorough cleaning and inspection, with the frequency depending on the usage and the operating environment.

***WARNING***

*Disconnect primary power at the source before opening the enclosure. Wait at least two minutes before opening the enclosure to allow the primary capacitors to discharge.*

To clean the unit, open the enclosure (please refer to the Section, "Opening the Enclosure", and use a vacuum cleaner to remove any accumulated dirt and dust. The unit should also be wiped clean, if necessary; with solvents that are recommended for cleaning electrical apparatus.

***CAUTION***

*Do not blow air into the power supply during cleaning. Blowing air into the unit can cause metal particles to interfere with sensitive electrical components and cause damage to the unit.*

## 5.02 Basic Troubleshooting

***WARNING***

*There are extremely dangerous voltages and power levels present inside this product. Do not attempt to open or repair unless you are an Accredited Thermal Arc Service Agent and you have had training in power measurements and troubleshooting techniques.*

If major complex subassemblies are faulty, then the Welding Power Source must be returned to an Accredited Thermal Arc Service Agent for repair.

The basic level of troubleshooting is that which can be performed without special equipment or knowledge.

## 5.03 TIG Welding Problems

Weld quality is dependent on the selection of the correct consumables, maintenance of equipment and proper welding technique.

| Description | Possible Cause | Remedy |
|---|---|---|
| 1 Excessive beard build-up or poor penetration or poor fusion at edges of weld. | A Welding current is too low | A Increase weld current and/or faulty joint preparation |
| 2 Weld bead too wide and flat or undercut at edges of weld or excessive burn through | A Welding current is too high | A Decrease weld current |
| 3 Weld bead too small or insufficient penetration or ripples in bead are widely spaced apart | A Travel speed too fast | A Reduce travel speed |
| 4 Weld bead too wide or excessive bead build up or excessive penetra-tion in butt joint | A Travel speed too slow | A Increase travel speed |
| 5 Uneven leg length in fillet joint | A Wrong placement of filler rod | A Re-position filler rod |
| 6 Electrode melts when arc is struck. | A Electrode is connected to the '+' terminal. | A Connect the electrode to the '?' terminal. |
| 7 Dirty weld pool. | A Electrode contaminated through contact with work piece or filler rod material. | A Clean the electrode by grinding off the contaminates. |
| | B Gas contaminated with air. | B Check gas lines for cuts and loose fitting or change gas cylinder. |
| 8 Electrode melts or oxidizes when an arc is struck. | A No gas flowing to welding region. | A Check the gas lines for kinks or breaks and gas cylinder contents. |
| | B Torch is clogged with dust. | B Clean torch |
| | C Gas hose is cut. | C Replace gas hose. |
| | D Gas passage contains impurities. | D Disconnect gas hose from torch then raise gas pressure and blow out impurities. |
| | E Gas regulator turned off. | E Turn on. |
| | F Torch valve is turned off. | F Turn on. |
| | G The electrode is too small for the welding current. | G Increase electrode diameter or reduce the welding current. |
| 9 Poor Weld Finish. | A Inadequate shielding gas. | A Increase gas flow or check gas line for gas flow problems. |

Table 5-1a: TIG Welding Problems

| Description | Possible Cause | Remedy |
|---|---|---|
| 10 Arc flutters during TIG welding. | A Tungsten electrode is too large for the welding current. | A Select the right size electrode. Refer to Basic TIG Welding guide. |
| | B Absence of oxides in the weld pool. | B Refer Basic TIG Welding Guide for ways to reduce arc flutter. |
| 11 Welding arc can not be established | A Work clamp is not connected to the work piece or the work/torch leads are not connected to the right welding terminals | A Connect the work clamp to the work piece or connect the work/torch leads to the right welding terminals. |
| | B Torch lead is disconnected. | B Connect it to the '?' terminal. |
| | C Gas flow incorrectly set, cylinder empty or the torch valve is off. | C Select the right flow rate, change cylinders or turn torch valve on. |
| 12 Arc start is not smooth. | A Tungsten electrode is too large for the welding current. | A Select the right size electrode. Refer to Basic TIG Welding Guide. |
| | B The wrong electrode is being used for the welding job | B Select the right electrode type. Refer to Basic TIG Welding Guide |
| | C Gas flow rate is too high. | C Select the correct rate for the welding job. Refer to Basic TIG Welding Guide |
| | D Incorrect shielding gas is being used. | D Select the right shielding gas. Refer to Basic TIG Welding Guide. |
| | E Poor work clamp connection to work piece | E Improve connection to workpiece |

Table 5-1b: TIG Welding Problems Continued

## 5.04 Stick Welding Problems

| | Description | | Possible Cause | | Remedy |
|---|---|---|---|---|---|
| 1 | Gas pockets or voids in weld metal (Porosity). | A | Electrodes are damp. | A | Dry electrodes before use. |
| | | B | Welding current is too high. | B | Reduce welding current. |
| | | C | Surface impurities such as oil, grease, paint, etc. | C | Clean joint before welding. |
| 2 | Crack occurring in weld metal soon after solidification commences | A | Rigidity of joint. | A | Redesign to relieve weld joint of severe stresses or use crack resistance electrodes. |
| | | B | Insufficient throat thickness. | B | Travel slightly slower to allow greater build up in throat. |
| | | C | Cooling rate is too high. | C | Preheat plate and cool slowly. |
| 3 | A gap is left by failure of the weld metal to fill the root of the weld. | A | Welding current is too low. | A | Increase welding current . |
| | | B | Electrode too large for joint. | B | Use smaller diameter electrode. |
| | | C | Insufficient gap. | C | Allow wider gap. |
| | | D | Incorrect sequence. | D | Use correct build-up sequence |

Table 5-2a: Stick Welding Problems

Figure 5-1: Example of insufficient gap or incorrect sequence

| | | | |
|---|---|---|---|
| 4 | Portions of the weld run do not fuse to the surface of the metal or edge of the joint. | A | Small electrodes used on heavy cold plate. |
| | | B | Welding current is too low. |
| | | C | Wrong electrode angle. |
| | | D | Travel speed of electrode is too high. |
| | | E | Scale or dirt on joint surface. |
| | | A | Use larger electrodes and pre-heat the plate. |
| | | B | Increase welding current |
| | | C | Adjust angle so the welding arc is directed more into the base metal |
| | | D | Reduce travel speed of electrode |
| | | E | Clean surface before welding. |

Table 5-2b: Stick Welding Problems

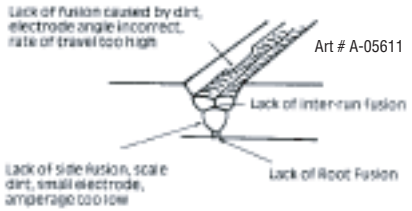

Lack of fusion caused by dirt, electrode angle incorrect, rate of travel too high
Art # A-05611
Lack of inter-run fusion
Lack of side fusion, scale dirt, small electrode, amperage too low
Lack of Root Fusion

Figure 5-2: Example of lack of fusion

| | Description | | Possible Cause | | Remedy |
|---|---|---|---|---|---|
| 5 | Non-metallic particles are trapped in the weld metal (slag inclusion). | A | Non-metallic particles may be trapped in undercut from previous run. | A | If bad undercut is present, clean slag out and cover with a run from a smaller diameter electrode. |
| | | B | Joint preparation too restricted. | B | Allow for adequate penetration and room for cleaning out the slag. |
| | | C | Irregular deposits allow slag to be trapped. | C | If very bad, chip or grind out irregularities. |
| | | D | Lack of penetration with slag trapped beneath weld bead. | D | Use smaller electrode with sufficient current to give adequate penetration. Use suitable tools to remove all slag from corners. |
| | | E | Rust or mill scale is preventing full fusion. | E | Clean joint before welding. |
| | | F | Wrong electrode for position in which welding is done. | F | Use electrodes designed for position in which welding is done, otherwise proper control of slag is difficult. |

Table 5-2c: Stick Welding Problems

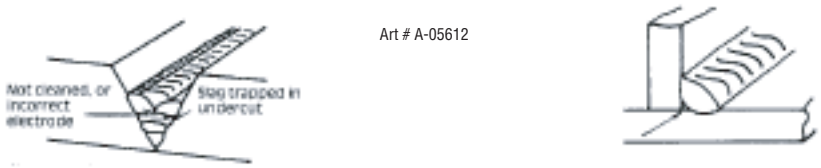



Figure 5-3: Examples of slag inclusion

## 5.05 Power Source Problems

| | Description | | Possible Cause | | Remedy |
|---|---|---|---|---|---|
| 1 | The welding arc cannot be established | A | The Mains supply voltage has not been switched ON. | A | Switch ON the Mains supply voltage. |
| | | B | The Welding Power Source switch is switched OFF. | B | Switch ON the Welding Power Source. |
| | | C | Loose connections internally. | C | Advanced Troubleshooting Guid |
| 2 | Maximum output welding curernt can not be achieved with nominal Mains supply voltage. | A | Defective control circuit | A | Advanced Troubleshooting Guide |
| 3 | Welding current reduces when welding | A | Loose Welding cable Connections | A | Tighten all welding cable connections |
| | | B | Incorrect welding cable size | B | User proper size and type of cable |
| | | C | Improper input connections | C | Refer to Section 3.03. |
| | | D | Poor electrode connections | D | Replace electrode |
| | | E | Wrong welding polarity | E | Verify output torch connections |
| 4 | No gas flow when the torch trigger switch is depressed. | A | Gas hose is cut. | A | Replace gas hose. |
| | | B | Gas passage contains impurities. | B | Disconnect gas hose from the rear of Power Source then raise gas pressure and blow out impurities. |
| | | C | Gas regulator turned off. | C | Turn gas regulator on. |
| | | D | Torch trigger switch lead is disconnected or switch/cable is faulty. | D | Reconnect lead or repair faulty switch/cable. |
| 5 | Gas flow won't shut off | A | Weld Mode (STD, SLOPE, REPEATor SPOT) was changed before POST-FLOW gas time had finished. | A | Strike an arc to complete the weld cycle. OR Must switch machine off then on to reset solenoid valve. |
| | | B | Gas valve is faulty. | B | Refer to section Advanced Power Source Problems Problem 2 |
| | | C | Gas valve jammed open. | C | Refer to section Advanced Power Source Problems Problem 2 |
| | | D | POST-FLOW control is set to 60 sec. | D | Reduce *POST-FLOW* time. |
| 6 | The TIG electrode has been contaminated due to the gas flow shutting off before the programmed POST-FLOWtime has elapsed | A | The Weld Process Mode (STICK, HF TIG or LIFT TIG) was changed before POST-FLOWgas time had finished. | A | Do not change Weld Process Mode before the *POST-FLOW* gas time had finished. |

Table 5-3: Power Source Problems

## 5.06 VOLTAGE REDUCTION DEVICE (VRD)

### VRD Specification

| Description | P-Wee 160TS | Notes |
|---|---|---|
| VRD Open Circuit Voltage | 15.3 to 19.8V | Open circuit voltage between welding terminals |
| VRD Resistance | 148 to 193 ohms | The required resistance between welding terminals to turn ON the welding power |
| VRD Turn OFF Time | 0.2 to 0.3 seconds | The time taken to turn OFF the welding power once the welding current has stopped |

Table 5-4: VRD Specifications

### VRD Maintenance

Routine inspection and testing (power source)

An inspection of the power source, an insulation resistance test and an earth resistance test should be carried out

a) For transportable equipment, at least once every 3 months; and

b) For fixed equipment, at least once every 12 months.

The owners of the equipment shall keep a suitable record of the periodic tests.

***Note***

*A transportable power source is any equipment that is not permanently connected and fixed in the position in which it is operated.*

In addition to the above tests and specifically in relation to the VRD fitted to this machine, the following periodic tests should also be conducted by an accredited Thermal Arc service agent.

| Description | IEC 60974-1 Requirements |
|---|---|
| VRD Open Circuit Voltage | Less than 20V; at Vin=230V |
| VRD Turn ON Resistance | Less than 200 ohms |
| VRD Turn OFF Time | Less than 0.3 seconds |

Table 5-5: VRD Tests

If this equipment is used in a location or environments with a high risk of electrocution then the above tests should be carried out prior to installation at this location.

## 5.07 POWER SOURCE ERROR CODES

| | Description | Possible Cause | Remedy | Remarks |
|---|---|---|---|---|
| 1 | **E01** error code displayed: Temperature sensor TH1 (protects IGBTs) is greater than 90°C for about 1 second | A The Welding Power Source's duty cycle has been exceeded. | A Let Power Source cool down then keep within its duty cycle. | Weld current ceases. Buzzer sounds constantly. E01 resets when TH1 decreases to 70°C for about 30 seconds. |
| | | B Fan ceases to operate. | B Please refer to advanced troubleshooting. | |
| | | C Air flow is restricted by vents being blocked | C Unblock vents then let Power Source cool down. | |
| 2 | **E03** error code displayed: Primary (input) current too high | A Primary current is too high because welding arc is too long. | A Reduce length of welding arc. | Weld current ceases. Buzzer sounds constantly. Switch machine off then on to reset E03 error. |
| | | B Mains supply voltage is more than 10% below nominal voltage | B A qualified electrician checks for low Mains voltage or refers to advanced troubleshooting | |
| 3 | **E11** error code displayed: Over Primary supply (input) voltage at primary capacitors is exceeded for one second | A Primary supply voltage is greater than the nominal voltage plus 10%. | A A qualified electrician checks the Primary voltage or refers to the following chapter. | Weld current ceases. Buzzer sounds constantly. Error code E11 automatically will reset when the voltage reduces. |
| 4 | **E12** error code displayed: Under mains supply (input) voltage primary capacitors is reduced for one second | A Mains supply voltage is down to dangerously low level. | A A qualified electrician checks the Mains voltage, checks the primary cable & fuses or refers to advanced troubleshooting. | Weld current ceases. Buzzer sounds constantly. Error code E12 automatically will reset when the voltage reduces. |
| 5 | **E85** error code displayed: Pre-charge abnormality | A Due to malfunction inside the Welding Power Source, primary capacitors are not charging correctly. | A Please refer to Advanced Troubleshooting. | No weld current is available. Buzzer sounds constantly. Switch machine off then on to reset E85 error. |
| 6 | E93 error code displayed Memory chip (EEPROM) on control PCB can not read/write weld parameters | A Memory chip (EEPROM) error | A Please refer to Advanced Troubleshooting | Weld current ceases. Buzzer sounds constantly. Switch machine off. |
| 7 | E94 error code displayed Temperature sensor TH1 for IGBTs or sensor TH2 for secondary diodes are open circuit | A The Welding Power Source's temperature sensors have malfunctioned. | A Please refer to Advanced Troubleshooting. | Weld current ceases. Buzzer sounds constantly. Switch machine off. |
| 8 | E99 error code displayed Mains supply (input) voltage has been turned off but control circuit has power from the primary capacitors | A Main on/off switch on machine has been turned off | A Turn on/off switch on. | Weld current ceases. Buzzer sounds constantly. Must switch machine off then on to reset E99 error. |
| | | B Mains supply (input) voltage has been turned off | B Please refer to Advanced Troubleshooting. | |

Table 5-6: Power Source Error Codes

# SECTION 6:
# ADVANCED TROUBLESHOOTING

If you are here, all of the troubleshooting suggestions in Section 5- Basic Troubleshooting have either failed to resolve the faulty operation or have indicated that one or more of the subsystems within the power supply are defective. This section provides the information needed to take live measurements on the various subsystems within the power supply, and replace those subsystems that prove faulty.

***CAUTION***

*Troubleshooting and repairing this unit is a process, which should be undertaken only by those familiar with high voltage/high power electronic equipment.*

***WARNING***

*There are extremely dangerous voltage and power levels present inside this unit. Do not attempt to diagnose or repair unless you have training in power electronics, measurement and troubleshooting techniques.*

Under no circumstances are field repairs to be attempted on printed circuit boards or other subassemblies of this unit. Evidence of unauthorized repairs will void the factory warranty. If a subassembly is found to be defective by executing any of the procedures in this Service Manual, the subassembly should be replaced with a new one. The faulty subassembly should then be returned to Thermal Arc through established procedures.

***WARNING***

*Disconnect primary power at the source before disassembling the power supply. Frequently review the Important Safety Precautions (page iii). Be sure the operator is equipped with proper gloves, clothing and eye and ear protection. Make sure no part of the operator's body comes into contact with the work piece or any internal components while the unit is activated.*

## 6.01 System-Level Fault Isolation

If none of the suggestions provided in Section 5 have solved the problem or corrected the faulty operation, the next step is to isolate one or more of the internal subassemblies that may be defective.

***CAUTION***

*Perform all steps in each procedure, in sequence. Skipping portions of procedures, or performing steps out of sequence can result in damage to the unit, and possible injury, or worse, to the operator.*

### Opening the Enclosure

1. Confirm that the switch of power supply and the switch on the switchboard (distribution panel) are all OFF.

***CAUTION***

*The capacitors inside the power supply will slowly discharged after you turn off the switch of the power supply or the switch at the breaker box (distribution panel). Wait at least 5 minutes for the discharge to complete.*

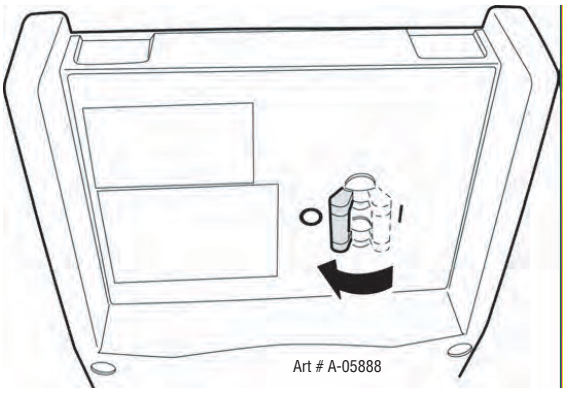



Figure 6-1: Confirm Power Switch is Off

2. Remove all screws and nuts on the side covers.

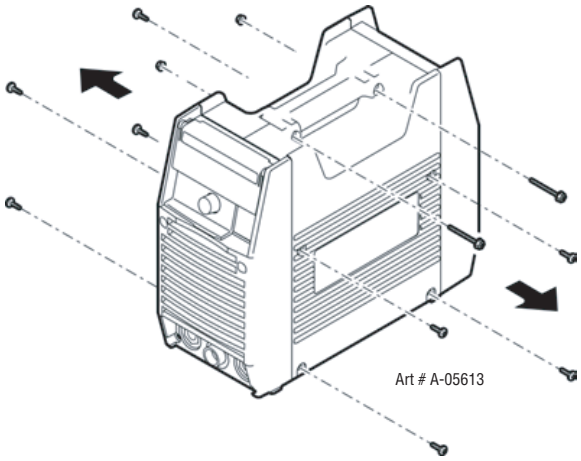



Figure 6-2: Remove side panel screws and nuts.

3. Loosen the screws on the front panel and the rear panel by turning them approximately twice.

***NOTE***

*Do NOT remove the screws completely.*

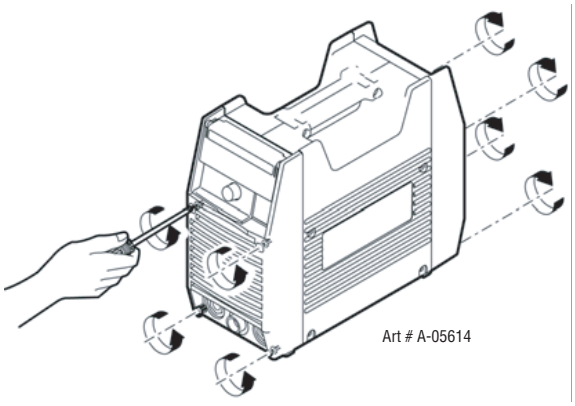



Figure 6-3: Loosen front and rear panel screws.

4. Pull the front panel slightly forward and pull the rear panel slightly backward. The interlocking hooks of the side case covers can now be disengaged from the front and rear panels.

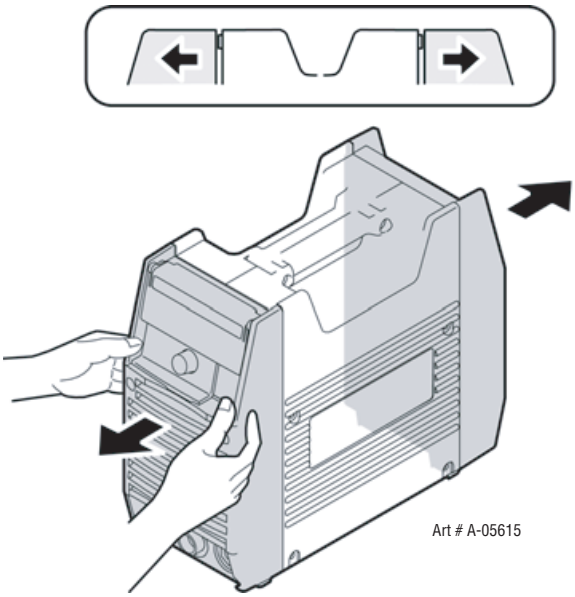



Figure 6-4: Disengage front and rear interlocking hooks.

5. Remove the side covers.

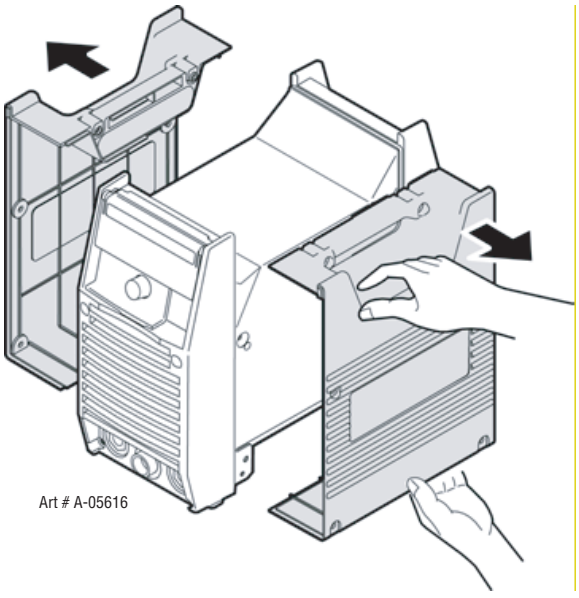



Figure 6-5: Remove side panels.

6. Remove protection cover sheet by removing the plastic tabs.

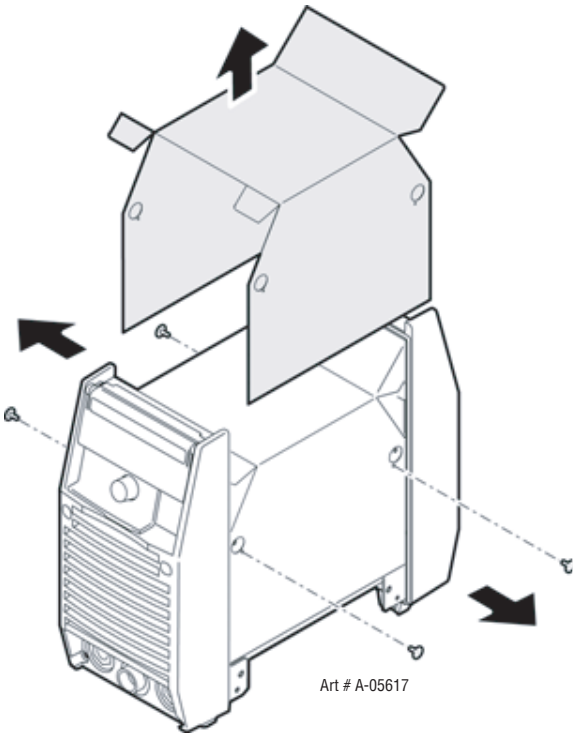



Figure 6-6: Remove cover sheet.

***NOTE***

*When you reassemble the parts, conduct this entire process backwards.*

## 6.02 Verification and Remedy to the Indicated Error Codes

***NOTE***

*The capacitors inside the power supply will slowly discharged after you turn off the switch of the power supply or the switch at the breaker box (distribution panel). Wait at least 5 minutes for the discharge to complete and then remove the cases to continue your inspection and repair (or maintenance) inside the power supply. As for the removal and installation of the case, refer to Section 6.01.*

***NOTE***

*During the "Verification/Remedy" procedures below, follow the alphabetical sequence (a, b, c…) and proceed with your verification and confirmation.*

***NOTE***

*After you confirm and replace all spare parts and components, confirm that there are no damaged harnesses or connectors, uninstalled or loose screws.*

The symptoms, causes, and solutions to the error codes indicated will be in the following format:

**1. Symptom**

*Cause*

a) Remedy, the first remedy being the most common and the first to be checked.

**1. E85 "Pre-Charge Error"**

*Occurs, after you apply power, when a failure is detected during the preliminary charging of the capacitors.*

a) Verify the AC input voltage and the Capacitor Bus Voltage on PCB1 (WK-4980).

· Follow the instruction in section 6.05.

b) Verify the input diode, D1.

· Refer to section 6.17 for the test and replacement of D1.

c) Verify the IGBT, Q1.

· Refer to section 6.18 for the test and replacement of Q1.

d) Replace PCB1 (WK-4980) and PCB2 (WK-4977).

· If the tests in the above sections (a, b, c) are within expected results and the unit is still defective, replace PCB1 and PCB2.

· Refer to section 6.12 for the replacement of PCB1 and section 6.13 for PCB2.

**2. E11 "High Input Voltage Failure"**

*Occurs when the input voltage is more than approximately 275VAC (= 1/1.41 of the maximum value of the sinusoidal wave).*

a) Verify input voltage.

· Follow the instruction in section 6.05.

b) Replace PCB2 (WK-4977).

· If the voltage and current available is determined to be sufficient, replace PCB2.

· Refer to section 6.13 for the replacement of PCB2.

**3. E12 "Low Input Voltage Failure"**

*Occurs when the input voltage is less than approximately 150VAC (= 1/1.41 of the maximum value of the sinusoidal wave).*

a) Verify input voltage.

· Follow the instruction in section 6.05.

b) Replace PCB2 (WK-4977).

· If the voltage and current available is determined to be sufficient, replace PCB2.

· Refer to section 6.13 for the replacement of PCB2.

**4. E01 "Over-Temperature at the primary side"**

*Occurs when an over-temperature condition of the primary IGBT is detected.*

a) Unit may be in thermal shutdown mode.

· Review the rated duty cycle of the unit per section 3.04. Exceeding the duty cycle can damage the unit and void the warranty.

b) Verify the ventilation condition

- Maintain a clear and unobstructed distance of more than 30cm in the front and more that 50cm in the rear of the unit for ventilation purposes.
- Verify and maintain clean, dust free, front and rear airflow paths. Cleaning and removing dust from the front and rear panels once every six months in a normal working environment is recommended. Extremely dusty environments will require more frequent cleaning.

c) Verify the operation of the cooling fan, FAN, and replace it if necessary.

- Verify the condition of FAN1. Verify that there are no broken or cracked fan blades and that the FAN is not producing any abnormal sounds.
- If broken or cracked FAN1 blades, or abnormal sounds are emanating from FAN1, replace FAN1.
- Refer to section 6.25 for the replacement of FAN1.
- Refer to section 6.07 for addition FAN1 tests.

d) Verify the operation of the cooling fan and replace it if the condition of FAN1 is inactive.

- Follow the instruction in section 6.07.

e) Replace PCB5 (WK-4986) and PCB6 (WK-4987).

- Refer to section 6.15 for the replacement of PCB5 and PCB6.

**5. E03 "Primary Over-Current Failure"**

*Occurs when excessive current is detected flowing into the primary side of the main transformer.*

a) Confirm the operation of the machine within the rated specification.

- Refer to the specification data sheet in Section 2.

b) Verify the secondary diode (D2 and D3).

- Refer to section 6.19 for the test and replacement of D2 and D3.

c) Verify the H.F. unit (HF. UNIT).

- Refer to section 6.26 for the replacement of HF. UNIT1.

d) Verify the primary IGBT (Q1).

- Refer to section 6.18 for the test and replacement of Q1.

e) Replace the Hall CT, CT1.

***NOTE***

*Pay special attention to installed direction of CT1. The Hall CT will not function properly if installed in the incorrect direction.*

- Refer to section 6.24 for the replacement of CT1.

**6. E93 "Memory Failure"**

*Occurs when the memory fails to save the requested welding parameters.*

a) Replace PCB5 (WK-4986) and PCB6 (WK-4987).

- Refer to 6.15 for the replacement of PCB5 and PCB6.

**7. E94 "Thermistor Failure"**

*Occurs when the thermistor for the temperature detection circuitry is open.*

a) Verify the wiring harness and connection between CN8 on PCB6 (WK-4987) and thermistors TH1.

- Confirm a secure connection of the harness wired between CN8 on PCB6 and TH1 and reinstall the harnesses with a secure connection.
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.

b) Replace thermistors, TH1.

- Refer to section 6.20 for the replacement of TH1.

c) Replace PCB5 (WK-4986) and PCB6 (WK-4987).

- Refer to section 6.15 for the replacement of PCB5 and PCB6.

**8. E99 "Initial Power Receiving"**

*Occurs when the initial AC power-received signal has not reached the CPU.*

***NOTE***

*This error occurs normally during the power "OFF" sequence of the unit.*

a) Verify the wiring harness and connection of CN1 on PCB5 (WK-4986) and CN8 on PCB2 (WK-4977).

- Confirm a secure connection of the harness wired between CN1 on PCB5 and CN8 on PCB2 and reinstall the harness with a secure connection.
- Contact the manufacturer if you find any broken connectors or damaged wiring harness.

b) Verify and replace PCB2 (WK-4977).

- Confirm a secure connection of the harness wired between CN13 on PCB1 and CN12 on PCB2 and reinstall the harness with a secure connection.
- Refer to section 6.13 for the replacement of PCB2.

c) Replace PCB5 (WK-4986) and PCB6 (WK-4987).

- Refer to section 6.15 for the replacement of PCB5 and PCB6.

## 6.03 Verification and Remedy to Failures without Indication Codes

See Notes on page 6-4 and symptom, cause, remedy example on the same page.

**1. "Cooling Fan Failure" (Fan is not rotating.)**

*Occurs when the cooling fan is defective, damaged or the driving voltage is incorrect.*

a) Verify the cooling fan, FAN1.

- Inspect the condition of the fan blades and all peripheral parts. Clean the fan blades and all peripheral parts if covered with dust. Cleaning and removing dust from the fan blades once every 6 months in a normal environment is recommended. Extremely dusty environments will require more frequent cleanings.
- Verify that there are no wiring harnesses entangled inside the fan, confirm that the harnesses do not have any brakes in the wire or damaged connectors.
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.
- Replace the fan if there are any broken, cracked or missing fan blades.
- Refer to section 6.25 for replacement of FAN1.

b) Verify the wiring harness between the cooling fan (FAN1) and CN3 on PCB2 (WK-4977).

- Confirm a secure connection of the harness to CN3 on PCB2.
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.

c) Cooling fan voltage tests and replacement of the cooling fan (FAN1).

- Follow the instruction in section 6.07.

**2. "Gas Valve Failure" (No Gas flow through unit)**

*Occurs when the gas valve is defective, damaged or the driving voltage is incorrect.*

a) Confirm that TIG welding is selected on the welding mode.

- Do not change welding modes while welding.
- Only change welding modes when the unit is idle (torch switch OFF).
- Verify the setting of Pre-flow and Post-flow on the front panel.
- If the Pre-flow or Post-flow time is set to 0 seconds, change them to a higher setting.

b) Verify the layout the of the gas hose.

- Confirm that the hose is securely connected into the fitting at the inlet and the outlet.
- Confirm that the layout of the gas hose so that it is not bent or kinked.
- Confirm there are no breaks, burns or holes in the hose.
- Confirm the layout of the TIG torch gas hose and that the hose adapters are properly connected.

c) Gas Valve (SOL) voltage tests and replacement.

- Follow the instruction in section 6.08.

d) Replace the PCB5 (WK-4986) and PCB6 (WK-4987).

- Refer to section 6.15 for the replacement and installation of PCB5 and PCB6.

**3. "No weld output"**

***NOTE***

*When in High Frequency TIG (HF TIG) mode, if the High Frequency is not generated (present), refer to "High Frequency Output Failure" (symptom 5) before performing this section.*

*Occurs when the 8-pin connector or associated circuitry is defective, damaged, or the TIG torch cable is defective.*

***CAUTION***

*Read and understand this entire section before proceeding. Extreme personal harm and test equipment damage will occur if the procedures are not performed accurately.*

a) Verify the 8-pin connector. (Applies to LIFT TIG and High Frequency TIG (HF TIG) mode.)

- Confirm a secure between CON1 of the 8-pin connector and the remote device.
- Confirm a secure connection of the harness and the connections between CON1 and PCB2 (WK-4977) are all correct and there are no open circuits.
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.
- Confirm the proper pins-outs of the 8-pin connector at the TIG Torch side. (Refer to section 4.01.)
- Confirm that there is no open circuit on the 8-pin connector at TIG Torch side.

b) Verify the condition and connections of the welding cable, the stick rod holders and the ground clamp. (Applies to all welding modes.)

- Confirm a secure connection of the welding cable, stick rod holders, ground clamp and dinse connectors and there are no open circuits.

c) Verify the no-load voltage (OCV). (Applies to STICK, High Frequency TIG (HF TIG) mode.)

- Refer to the section "Verification of No-load voltage (No OCV)" in section 6.08 first before continuing this section.
- If performing the "No-Load Voltage Failure" procedure does not rectify the failure, perform the following tests in the sequence below. Replace any defective components found.
  1) Diode, D2, D3. (Refer to the Section, 6.19)
  2) Coupling coil, CC. (Refer to the Section, 6.21)
  3) Reactor, L1. (Refer to the Section, 6.22)
  4) Transformer, T1. (Refer to the Section, 6.23)
  5) IGBT, Q1. (Refer to the Section, 6.18)
  6) Hall CT, CT1. (Refer to the Section, 6.24)

**4. "Operating Panel Failure" (LED's do not light properly or welding setting cannot be establish.)**

*Occurs when there is a connection failure among PCB4 (WK-4985), PCB5 (WK-4986) and PCB2 (WK-4977) or PCB5 and PCB2 are defective.*

a) Verify the harness connection between CN4 on PCB2 (WK-4977) and CN1 on PCB5 (WK-4986).

- Confirm a secure connection of the harness and the connections between CN4 on PCB2 and CN1 on PCB5.
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.

b) Verify the connection between PCB4 (WK-4985) and PCB5 (WK-4986).

- Confirm that all four connectors between PCB4 and PCB5 are tightly connected.
- Confirm the condition of the pins on the connectors and the connectors themselves, if bent pins or damaged connectors are found, replace the suspected PCB.
- Refer to section 6.14 for the replacement and installation of PCB4 and section 6.15 for PCB5 (PCB6, WK-4987).

c) Verify the connection between CN13 on PCB1 (WK-4980) and CN12 on PCB2 (WK-4977).

- Confirm a secure connection between CN13 on PCB1 (WK-4980) and CN12 on PCB2 (WK-4977).

d) Replacement of PCB2 (WK-4977), PCB5 (WK-4986) and PCB6 (WK-4987).

- Refer to section 6.13 for the replacement and installation of PCB2 and section 6.15 for PCB5 and PCB6

**5. "High Frequency Output Failure" (Unit does not generate High Frequency.)**

*Occurs when the HF. UNIT is defective or blown.*

***CAUTION***

*Read and understand this entire section before proceeding. Extreme personal harm and test equipment damage will occur if the procedures are not performed accurately. The unit will generate a High Voltage component that can cause extreme personal harm and test equipment damage.*

a) Verify the connection between High Frequency (HF. Unit) and Coupling Coil (CC).

- Verify the connection between the HF. Unit and CC; confirm that the quick-disconnect terminals are inserted onto the terminals of HF. Unit, CC1 and CC2, correctly and completely.
- Confirm there are no short circuits, burnt or broken wires between the HF unit and the CC.
- Refer to section 6.21 for the replacement and installation of the CC.

b) Verify the connection between High Frequency (HF. Unit) and Current limiting Resistor (R2).

- Verify the connection between the HF. Unit and R2; confirm that the quick-disconnect terminals are inserted onto the terminals of HF. Unit, R1 and R2, correctly and completely.
- Confirm there are no short circuits, burnt or broken wires between the HF unit and R2.

c) Verify the connection between the terminals between AC1 – AC2.

- Verify the connection between AC1 and AC2. Confirm that the quick-disconnect terminals are inserted onto the terminals of HF. Unit correctly and completely.
- Confirm there are no short circuit, in the harness between AC1 and AC2.

d) Verify and replace the Gap (GAP) of the High Frequency (HF. Unit).

- Confirm that the GAP is connected to H.F. Unit correctly and completely.
- Confirm there is no dust or foreign debris between the space of the GAP.
- If there are any abnormalities observed with the GAP, replace the GAP.
- The GAP is factory set for an optimal setting for most welding applications. It is recommended that the GAP setting not be changed. The GAP is factory set at 0.8mm.
- If the GAP is increased (larger than 0.8mm), the HF voltage increases and the frequency tends to decrease. If the GAP is increased too much, HF will no longer be generated.
- If the GAP is decreased (smaller than 0.8mm), the HF voltage decreases and the frequency tends to increase.

e) Verify and replace the Current limiting Resistor (R2) of the High Frequency (HF. Unit).

- If R2 is defective (blown, burnt, cracked, etc.), replace R2.
- Refer to section 6.27 for the replacement and installation of R2.

f) Replace the High Frequency (HF. Unit).

- Refer to section 6.26 for the replacement and installation of HF. Unit.

## 6.04 Preparation of Fault Isolation Tests

The following initial conditions must be met prior to starting any of the procedures in this section.

1) Connect the appropriate input voltage. (Check the data tag on the rear of the power supply for the proper input voltage.)

***NOTE***

*Operate at ALL input voltages as noted on the nameplate on the rear panel when testing the power supply.*

2) Close primary power source wall disconnect switch or circuit breaker.

3) Place the power supply MAIN CIRCUIT SWITCH (S1) on rear of unit in the ON position.

***WARNING***

*Dangerous voltage and power levels are present inside this unit. Be sure the operator is equipped with proper gloves, clothing and eye and ear protection. Make sure no part of the operator's body comes into contact with the work piece or any internal components while the unit is activated.*

## 6.05 Verification of the power input circuitry.

Refer to Notes on page 6-4.

1) Verify the AC input voltage using an AC voltmeter. Verify input voltage (Phase-to Phase) using an AC voltmeter. (The capability of the voltmeter should be more than 300VAC). Measure the point between lines U1 and V1 on the input switch, S1. The location of points U1 and V1 on switch S1 are indicated in Figure 6-7.

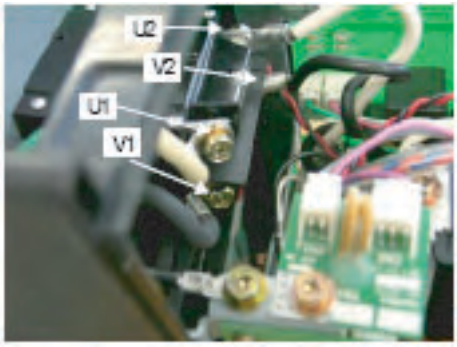



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Figure 6-7: Check points U1, U2, V1, V2

2) If the input voltage is out of the operating range of the unit, which is ± 10% (103~127VAC,187 ~ 253 VAC) of the rated voltage (115, 230V), verify the available power capacity at the installed site.

   If the input voltage is within the operating range, recheck the input voltage while welding, as welding may cause the input voltage to decrease to a value below the operating range of the unit.

3) Verify input voltage after the input switch (S1) using an AC voltmeter. (The capability of the voltmeter should be more than 300VAC.)

   Using an AC voltmeter, measure between the points U2 and V2 on the input switch, S1. The location of points U2 and V2 on switch S1 are indicated in Figure 6-7.

4) If this voltage is out of the operating range, which is ± 10% (103~ 127VAC,187 ~ 253 VAC) of the rated voltage (115, 230VAC), replace S1 following the process, in section 6.16

5) Verify the rectified output voltage of the input diode, D1 using a DC voltmeter. (The capability of the voltmeter should be more than 400VDC.)

   Using a DC voltmeter, measure between the points TB9[+] and of TB11(A)[-] on PCB1 (WK-4980).

   Points TB9 and TB11(A) are obtainable on the solder side of PCB1. See Figure 6-8. The measured voltage should be approximately 1.4 times larger than input voltage measured in #1. Replace diode D1 if the calculated measurement is not within the corresponding range (DC260 ~ 360 V) following the process in section 6.17.

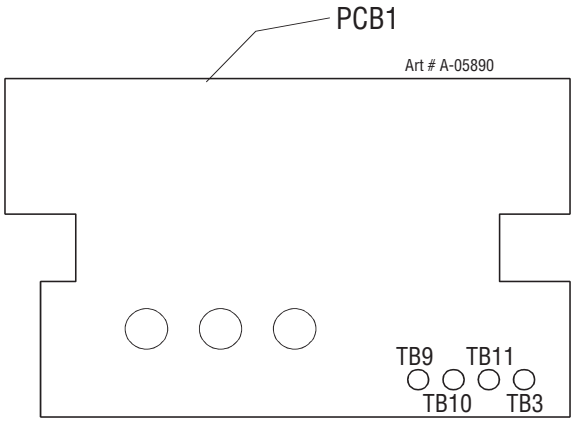


Figure 6-8: The check points TB9, TB11(A)

6) After the replacement of D1, if the above voltage is still abnormal, replace PCB1 (WK-4980) following the process in section 6.12.

## 6.06 Power Supply Voltage Test

1) Connect the power supply to a source of rated input voltage. (Check the data tag on the rear of the power supply for the proper input voltage.)

Refer to ***NOTE*** on page 6-10.

2) Apply power to the unit and place the switch of the power supply to the ON position.

3) On the PCB2 (WK-4977), measure the voltages according to Table 6-1. The test point and the reference are obtainable on the solder side of PCB2 (WK-4977). The location of points on CN4 on PCB2 (WK-4977) [circle as shown in Figure 6-9] are indicated in Figures 6-9 through 6-12.

| Test Point (PCB2; WK-4977) | Reference PCB2; WK-4977) | ACCEPTABLE VALUE |
|---|---|---|
| PIN1(CN4) | PIN4(CN4) | +12VDC |
| PIN2(CN4) | PIN4(CN4) | +5VDC |
| PIN3(CN4) | PIN4(CN4) | -12VDC |

Table 6-1: Test point voltage values.

4) If any of these voltages are not present or are below a 10% tolerance, replace the PCB2 (WK-4977) following the process in section 6.13

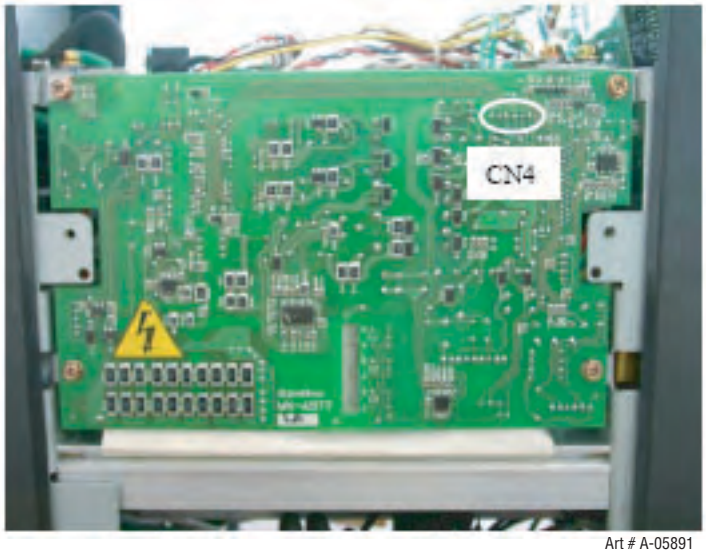


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Figure 6-9: Check point CN4 on PCB2

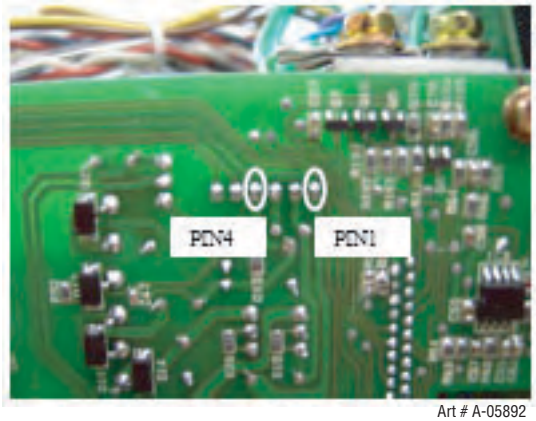


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Figure 6-10: Check Points +12V

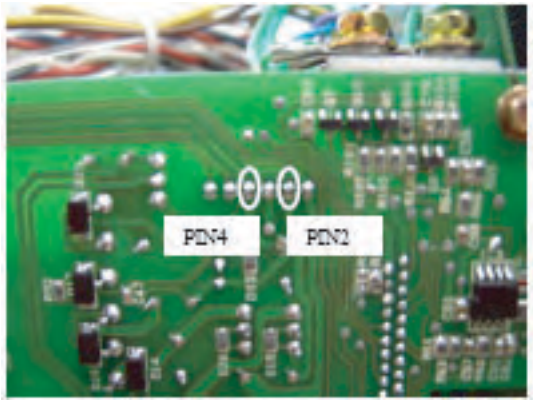


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Figure 6-11: Check Points +5V

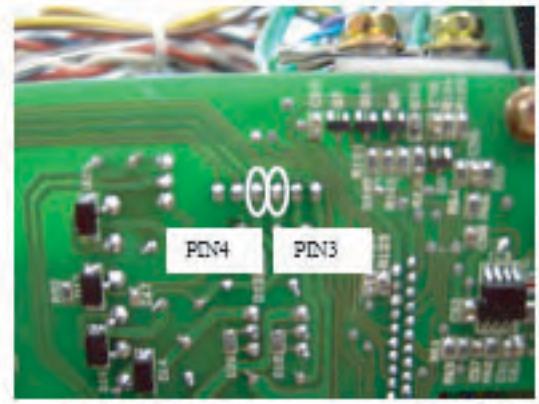


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Figure 6-12: Check Points -12V

## 6.07 Verification of the Cooling Fan1 and Drive Circuitry

1) Verify the condition of the cooling fan, FAN1, using a DC voltmeter. (The capability of the voltmeter should be more than 50VDC.) Using a DC voltmeter, measure between PIN 1[+] and PIN 2[-] of CN3 on PCB2 (WK-4977). The location of connector CN3 of PCB2 (WK-4977) is indicated in Figures 6-13 and Pin1 and Pin2 in 6-14.

***NOTE***

*When you measure the above voltage, do not remove the connector. Conduct the measurement while the connector plug and receptacle are still connected.*

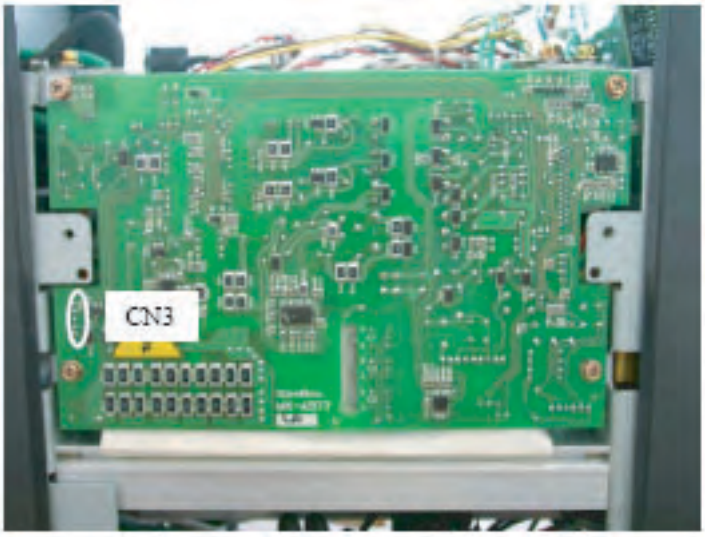


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Figure 6-13: Connector CN3 on PCB2

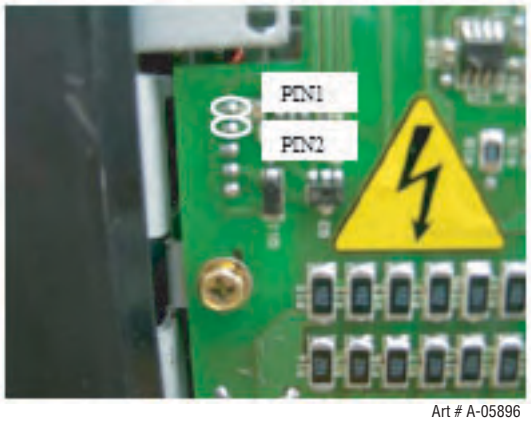


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Figure 6-14: Check Points on CN3 for Fan1

2) Using the measurement taken in step 1, follow Table 6-2 below for possible failure modes.

***NOTE***

*This welding unit has a feature that will slow the rotational speed of the cooling fan during low output current and while in standby. Under these conditions, the voltages in the above table will be inaccurate; therefore, when verifying the voltage, do so during the failure condition.*

***NOTE***

*When verifying the voltage, confirm that the AC input voltage remain within the operating range of the unit.*

| | Fan Status | Voltage measurement. (PIN 1 – PIN 2 of CN3 on PCB2) | Remedy |
|---|---|---|---|
| Case 1 | Rotating | DC 18 ~ 25V | Fan drive circuit is normal. |
| Case 2 | Rotating | Below DC 18V | Replace PCB2 (WK-4977). (Refer to section 6.13) |
| Case 3 | Inactive | Below DC 18V | Replace PCB2 (WK-4977). (Refer to section 6.13) |
| Case 4 | Inactive | DC 18 ~ 25V | Replace the FAN (Refer to Section 6.25) |

Table 6-2: Possible Failure Modes for Fan1

## 6.08 Verification of the Solenoid Valve and Drive Circuitry.

1) Verify the voltage between the PIN 3[+] and PIN 4[-] of connector CN3 on PCB2 (WK-4977) while you press the torch switch while in TIG Mode. (The capacity of the voltmeter should be more than 50VDC.) The location of connector CN3 of PCB2 (WK-4977) is indicated in Figures 6-15 through 6-16.

Refer to ***Note*** on page 6-14

2) Using the measurement taken above, follow the chart below for possible failure modes.

Refer to ***Notes*** on page 6-15.

| | **Voltage Measurment (Between PIN 3 – PIN 4 of CN3 on PCB2)** | **Remedy** |
|---|---|---|
| Case 1 | Below DC 18V | Replace PCB2 (WK-4977). (Refer to section 6.13) |
| Case 2 | DC 18 ~ 25V | Replace SOL. (Refer to section 6.28) |

Table 6-3: Possible failure modes for solenoid valve and drive circuitry

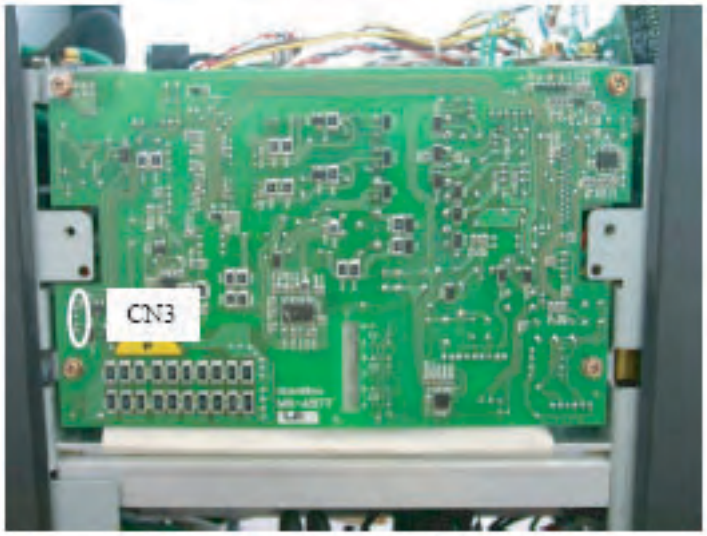


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Figure 6-15: The check point CN3 on PCB2

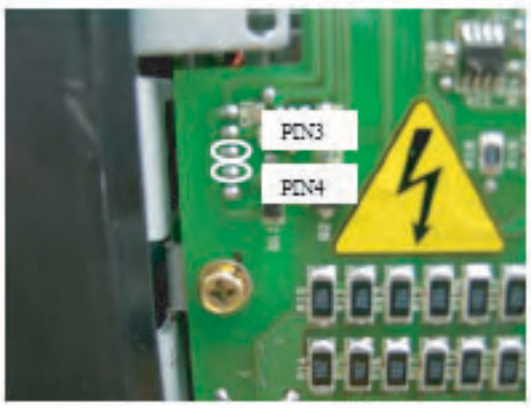


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Figure 6-16: Check points SOL Voltage

## 6.09 Verification of No-load voltage (No OCV)

1) Verify the no-load voltage in Stick mode.

**CAUTION**

*Electric shock hazard. The unit will generate OCV immediately when STICK mode is selected.*

a) In STICK welding mode, mark and then place PIN2 of DSW1 on PCB5 (WK-4986) in OFF position to turn off the electric shock protector function (Voltage-Reduction-Device, VRD).

b) Verify the no-load voltage using a DC voltmeter. (The capability of the voltmeter should be more than 100VDC.)

c) The normal no-load voltage is approximately 64V.

2) Verify the no-load voltage in High Frequency TIG (HF TIG) mode.

**CAUTION**

*Electric shock hazard and test equipment damage. The unit will generate OCV along with a High Voltage component that can cause extreme personal harm and test equipment damage.*

**NOTE**

*When in HF TIG mode, the unit will generate high voltage. To prevent personal harm and test equipment damage, remove the indicated wire from the HF. Unit shown in Figure 6-17 (circled as shown in Figure 20 left). To prevent electric shock, always wrap the removed wire with electrical tape or other suitable insulation.*

a) Confirm a secure connection between CON1 of the 8-pin connector and the TIG torch cable.

b) Confirm a secure connection of the harness and the connections between CON1 and PCB2 (WK-4977) are all correct and there are no open circuits.

c) Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.

d) While depressing the Torch switch, verify the OCV using a DC voltmeter. (The capability of the voltmeter should be more than 100VDC.)

**NOTE**

*In TIG mode, the OCV ceases 3 seconds after you depress the torch switch.*

e) The normal no-load voltage is approximately 64V.

f) Return PIN2 of DSW1 to the original position.

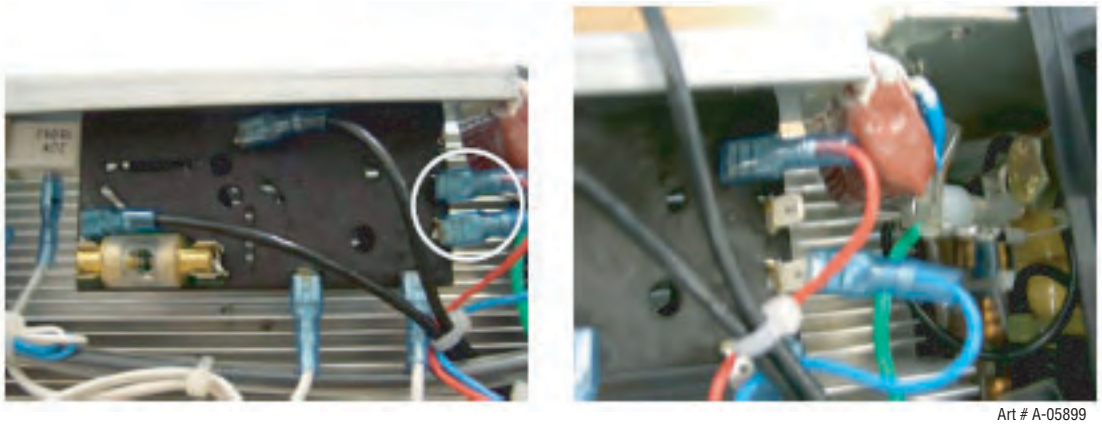

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Figure 6-17: Remove the indicated wire from the HF. Unit

## 6.10 Output Load Test

This test verifies that the output current, (amperage) controls are functioning properly. A clamp-type amperage meter or equivalent meter capable of reading approximately 180A full-scale will be needed for this test.

***CAUTION***

*Before performing any portion of the procedure below, make certain the unit is placed in the initial set up condition as described at the beginning of this section.*

1) Connect the POSITIVE (+) and NEGATIVE (-) OUTPUT TERMINALS to a piece of metal, separated by approximately three feet (one meter).
2) Connect the clamp-on amperage meter or equivalent to the output loop between the POSITIVE (+) and NEGATIVE (-) OUTPUT TERMINALS.
3) Place the power supply PRIMARY POWER SWITCH on the rear of the unit to the ON position.

***WARNING***

*This welding mode produces high frequency and high voltage. Extra care shall be taken to prevent electric shock.*

4) Select WELD position, press control knob. Set minimum current (counterclockwise).
5) Depress the torch switch. The amperage meter will indicate approximately 1 Amp.
6) Slowly turn the Control Knob clockwise to the maximum of the power supply, then counterclockwise, back to 1 Amp as the control returns to its minimum position. The amperage meter should indicate a continuous range of Amperes between the 1 Amp minimum and the 160A maximum.
7) Set minimum current (counterclockwise).
8) Press the Welding mode selection button to select STICK welding mode. The amperage meter will indicate approximately 1 Amps.

***WARNING***

*At this time, some voltage is applied to the stick electrode holder. Never touch the current conducting portion of it. Extra care shall be taken to prevent electric shock. Further, to prevent the risk of striking the arc inadvertently, care shall be taken to keep the work piece to be welded away from the said electrode holder.*

9) Slowly turn the Control Knob clockwise to the maximum of the power supply, then counterclockwise, back to 1 Amp as the control returns to its minimum position. The amperage meter should indicate a continuous range of Amperes between the 1 Amp minimum and the 160A maximum.
10) Place the power supply MAIN CIRCUIT SWITCH on the rear of the unit to the OFF position.
11) Remove the dead short between the OUTPUT TERMINALS.

***NOTE***

*This completes the output load test. If the results of any step differ from those above, then refer to the various test procedures in this section to isolate the problem.*

## 6.11 Preparation for Subsystem Test and Replacement procedures

The following sections provide specific procedures for verifying the operation and replacement of each subsystem within the power supply. Before undertaking any of these procedures, eliminate the obvious first- visually inspect the suspect subsystem for physical damage, overheating, and loose connections.

### Test and Replacement Parts List

| No. | Item Code | Description | Manual Section Number |
|---|---|---|---|
| 1 | PCB1 | Print Circuit Board WK-4980 | 6.12 |
| 2 | PCB4 | Print Circuit Board WK-4985 | 6.14 |
| 3 | PCB5 | Print Circuit Board WK-4986 (with PCB6) (with Flat Cable) | 6.15 |
| 4 | PCB2 | Print Circuit Board WK-4977 | 6.13 |

Table 6-4: Test and Replacement Parts List 1-4

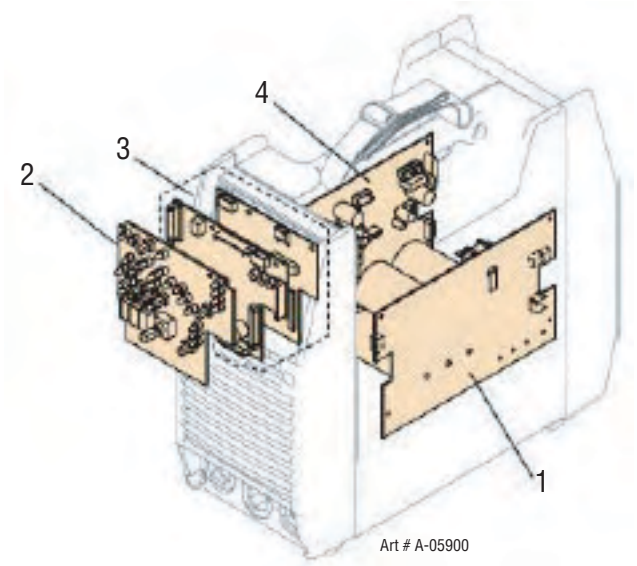



Figure 6-18: Location of PCB1, PCB2, PCB4, PCB5

| No. | Item Code | Description | Manual Section Number |
|---|---|---|---|
| 5 | T1 | Transformer | 6.23 |
| 6 | HF. UNIT | High Frequency Unit | 6.26 |
| 7 | CC | Coupling Coil | 6.21 |
| 8 | L1 | Reactor | 6.22 |

Table 6-5: Test and Replacement Parts List for T1, HF. UNIT, CC, L1

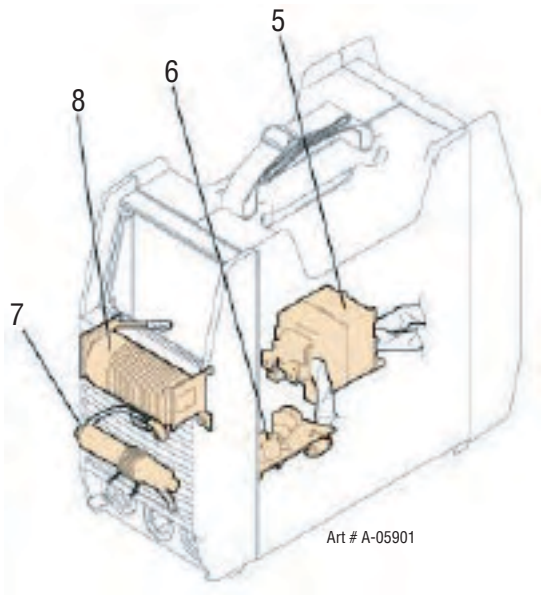



Figure 6-19: Location of T1, HF UNIT, CC, L1

| No. | Item | Description | Manual Section Number |
|---|---|---|---|
| 9 | S1 | Switch | 6.16 |
| 10 | FAN1 | Cooling Fan | 6.25 |
| 11 | SOL | Gas Valve | 6.28 |
| 12 | D1 | Diode (with PCB7) | 6.17 |
| 13 | TH1 | Thermistor | 6.2 |
| 14 | Q1 | IGBT (with PCB3) | 6.18 |
| 15 | R2 | Current-Limiting Resistor (HF. UNIT ) | 6.27 |
| 16 | CT 1 | Hall Current Transformer | 6.24 |
| 17 | D2,3 | Diode | 6.19 |

Table 6-6: Test and Replacement Parts List Continued

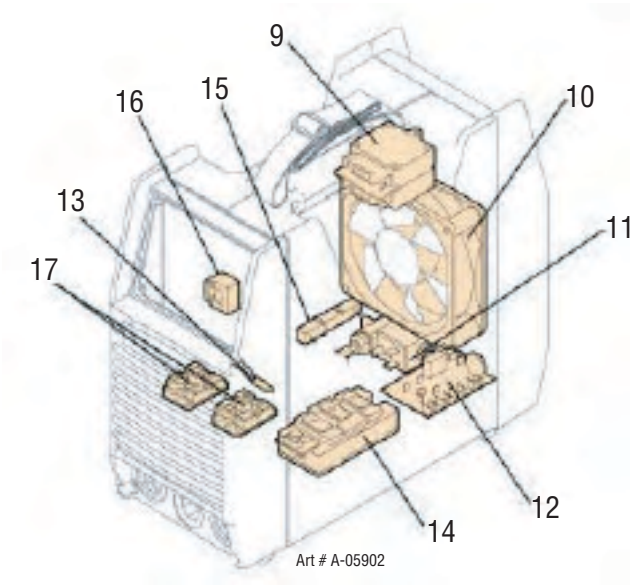



Figure 6-20: Location of above parts

## Service Tools

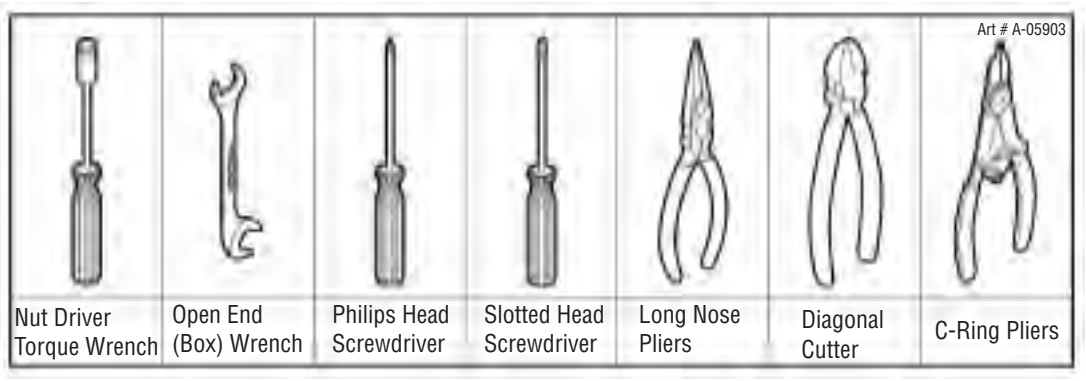



Figure 6-21: Service tools needed.

Nut driver and open end (box) wrench sizes:

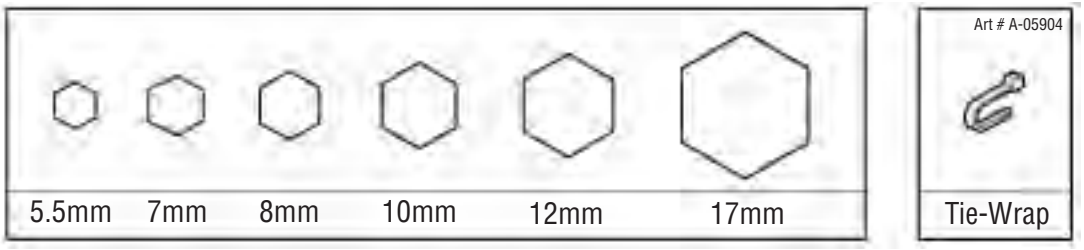



Figure 6-22: Nut driver and open end wrench sizes.

***NOTE***

*When removing the locking type connectors and board supporters, disengage the locking mechanism first and then disconnect them.*

***NOTE***

*Locking type connectors and board supporters are indicated in this manual using the following symbols; black star marks for locking connectors and white star marks for locking board supports.*

## 6.12 PCB1 Replacement Procedure

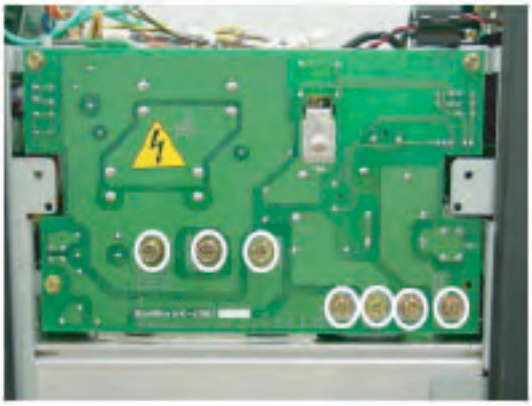
1) Remove the side covers. See section “6.01”.

2) Remove the three (3) screws (circled as shown in Figure 6-23) mounting PCB1 on chassis.

Art # A-05905

Figure 6-23: PCB1 mounted chassis

3) Remove the screws (4 places at input diode (D1), 3 places at primary IGBT (Q1), 7 places in total) mounting D1 and Q1 on PCB1, as shown in Figure 6-24.



Art # A-05906

Figure 6-24: Expanded view of PCB1

4) Remove the screw mounting main transformer (T1) on TB6 at PCB1 (circled as shown in Figure 6-25).

Art # A-05907

Figure 6-25: PCB1 top view

5) Pull PCB1 out frontward lightly.

Art # A-05908

Figure 6-26: PCB1 top view pushed out

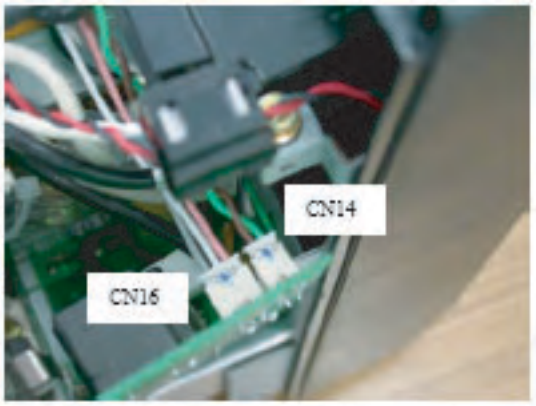
6) Unplug a harness connector from CN13 on PCB1.

Art # A-05909

Figure 6-27: CN13 on PCB1

7) Unplug harness connectors from CN14 and CN16 on PCB1.

   * Holding the upper portion of the harness (to unlock the contact between the harness connector and CN13, CN14, and CN16), pull the harness lightly. To unplug the harness connector, do not pull the harness excessively.




Art # A-05910

Figure 6-28: CN14 and CN16 on PCB1

8) Remove the screw mounting S1 with screwdriver, etc, as shown in Figure 6-29.

Art # A-05911

Figure 6-29: Power Supply with PCB1 pulled out

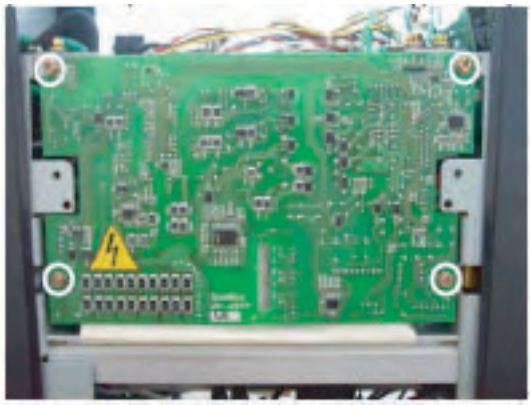
Art # A-05912

Figure 6-30: TB1 on PCB1

   * When you reassemble the parts, conduct this process backwards.

## 6.13 PCB2 Replacement Procedure

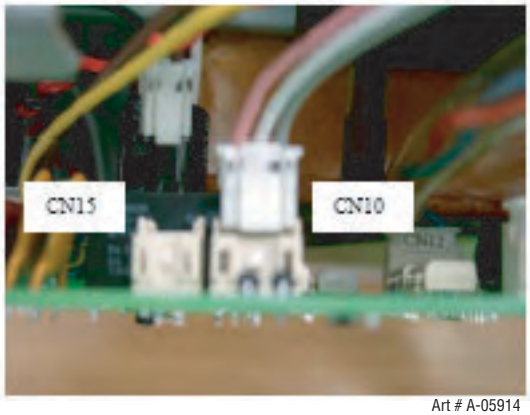
1) Remove the side covers. See section “6.01”.
2) Remove the four (4) screws (circled as shown in Figure 6-31) mounting PCB2 on chassis.



Art # A-05913

Figure 6-31: PCB2 mounted on chassis

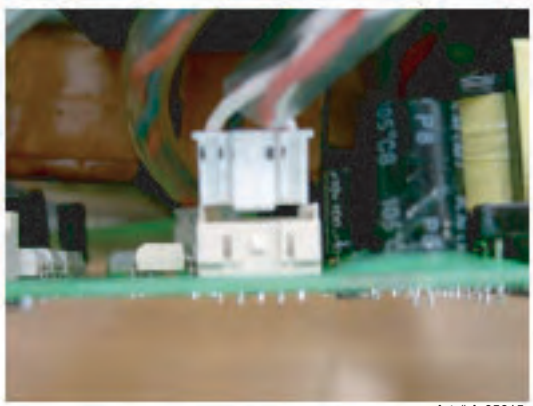
3) Unplug the harness connectors from CN10 and CN15 on PCB2.




Art # A-05914

Figure 6-32: CN15 and CN10 on PCB2

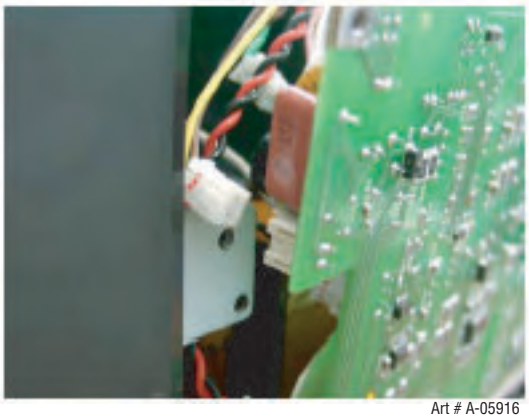
4) Unplug the harness connector from CN9 on PCB2.



Art # A-05915

Figure 6-33: CN9 on PCB2

5) Unplug the harness connector from CN2 on PCB2.



Art # A-05916

Figure 6-34: CN2 on PCB2

6) Unplug the harness connector from CN3 on PCB2.

Art # A-05917

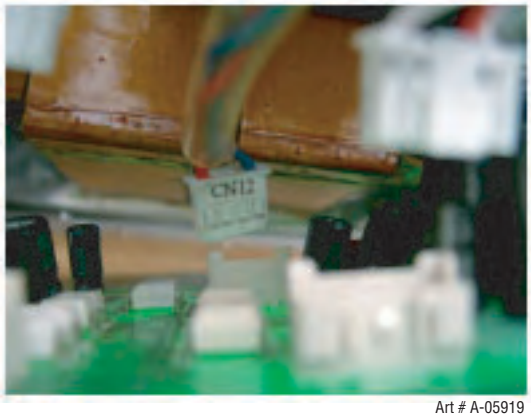
Figure 6-35: CN3 on PCB2

7) Unplug the harness connector from CN1 on PCB2.

Art # A-05918

Figure 6-36: CN1 on PCB2

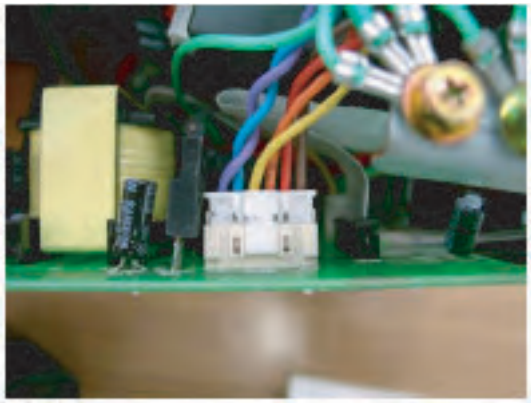
8) Unplug the harness connector from CN12 on PCB2.




Art # A-05919

Figure 6-37: CN12 on PCB2

9) Unplug the harness connector from CN4 on PCB2.



Art # A-05920

Figure 6-38: CN4 on PCB2

10) Unplug the harness connector from CN6 on PCB2.

Art # A-05921

Figure 6-39: CN6 on PCB2

11) Unplug the harness connector from CN8 on PCB2.

Art # A-05922

Figure 6-40: CN8 on PCB2

12) Unplug the harness connector from CN7 on PCB2.

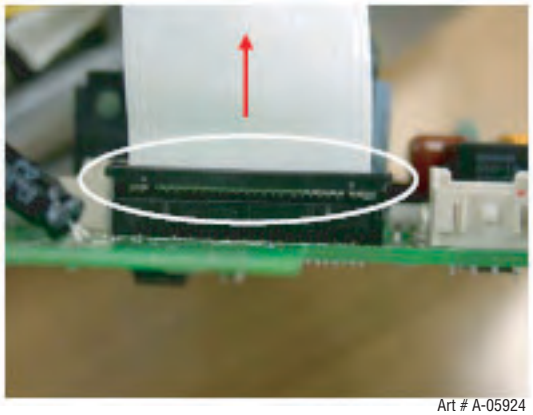
* Holding the upper portion of the harness (to unlock the contact between the harness connectors and CN1-4, CN6-10, CN12, and CN15), pull the harness lightly. To unplug the harness connector, do not pull the harness excessively.

ARt # A-05923

Figure 6-41: CN7 on PCB2

13) Disconnect a flat cable from CN5 on PCB2.

14) Pull up the retainer bar that is securing the flat ribbon cable into CN5 (circled as shown in Figure 6-42).



Art # A-05924

Figure 6-42: Retainer bar of CN5 on PCB2

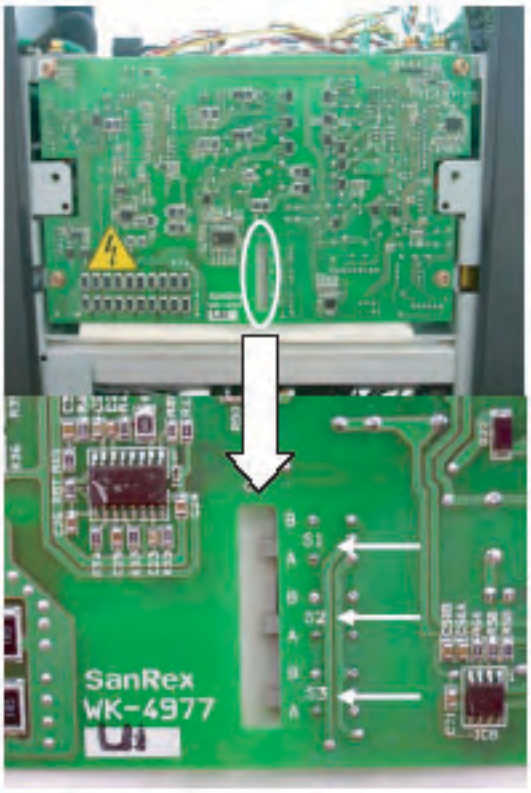
15) Disconnect the flat ribbon cable from CN5 connector by pulling straight up on the cable.

Art # A-05925

Figure 6-43: Removing cable from CN5

16) When reconnecting the flat cable, make sure that it is oriented in such a manner that its lug portion is positioned on the front side.

* When you reassemble the parts, conduct this process backwards.
* Check slide switches (S1, S2, and S3)
* Identify locations of slide switches (S1, S2, and S3).
* Make sure that all of S1, S2, and S3 are placed in their respective 'A' positions.




Art # A-05926

Figure 6-44: S1, S2, and S3 on PCB2

## 6.14 PCB4 Replacement Procedure

Art # A-05927

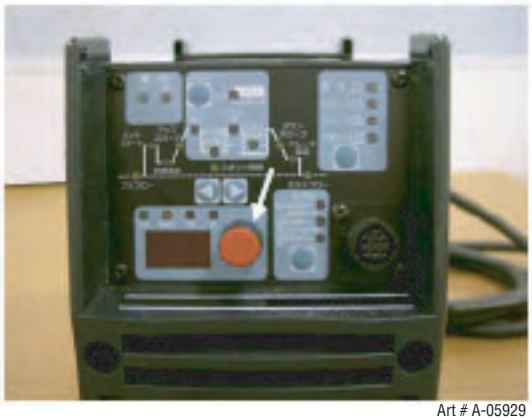
Figure 6-45: Power Source front view

1) Remove the side covers. See section “6.01”.
2) Remove the protection panel cover over the front panel.
   * To remove the protection panel cover, push both edges of the cover in slightly, as indicated by left and right arrows in Figure 6-46, and pull up the cover frontward.

Art # A-05928

Figure 6-46: Protection panel cover

3) Remove the cap on the control knob (indicated by arrow in Figure 6-47).



Art # A-05929

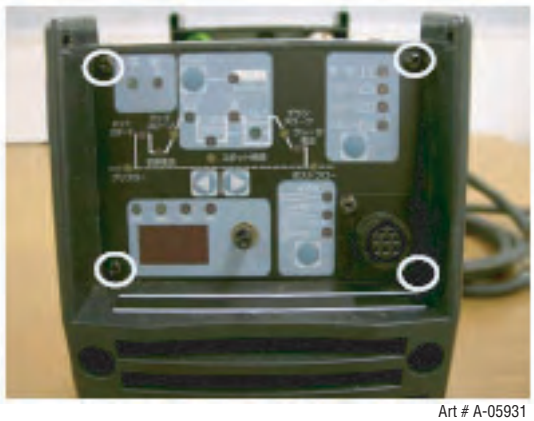
Figure 6-47: Operation Panel and control knob cap.

4) Remove screw (indicated by arrow in Figure 6-48) securing the control knob to the operation panel, loosen the screw and remove the control knob from operation panel.

Art A -05930

Figure 6-48: Control Knob Screw

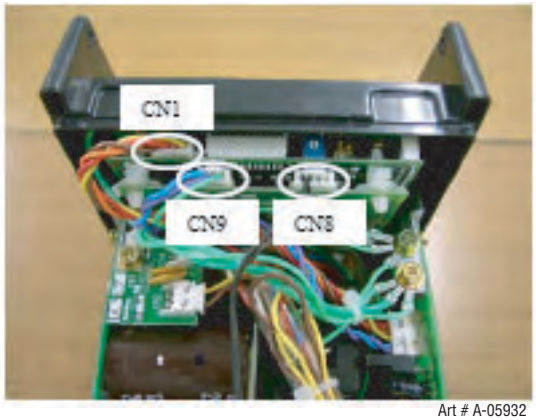
5) Remove the screws (4 places, circled as shown in Figure 6-49) holding the operation panel onto the front panel.



Art # A-05931

Figure 6-49: Operation panel with control knob removed.

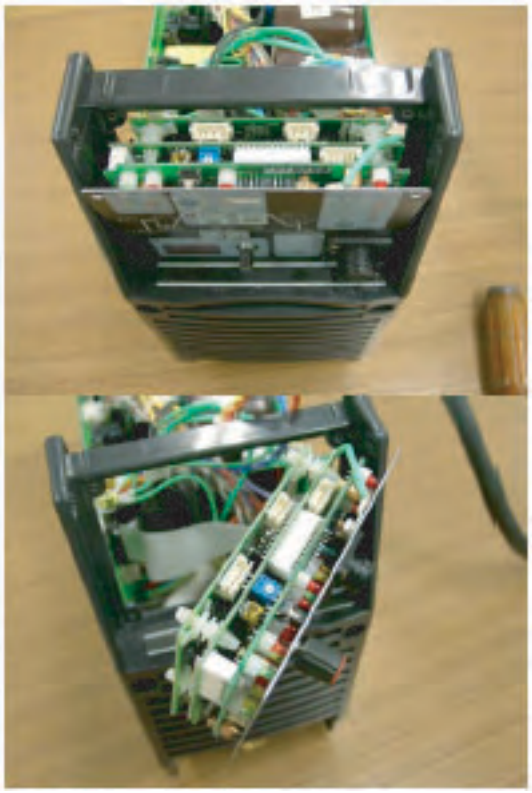
6) Unplug harness connectors (3 places, circled as shown in Figure 6-50) from CN1 on PCB5 and from CN8 and CN9 on PCB6.




Art # A-05932

Figure 6-50: Front side top view

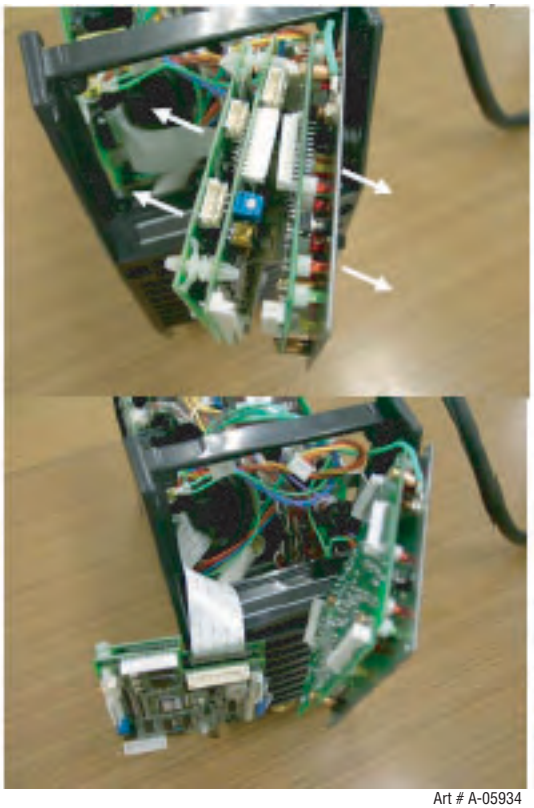
7) Pull the operation panel out of the front panel frontward.



Art # A-05933

Figure 6-51: Operation Panel removed from front panel.

8) Disconnect and remove PCB5 and PCB6 from PCB4 by pulling the two PCB's apart.



Art # A-05934

Figure 6-52: Disassembling the operation panel

9) Remove the screws (4 places, circled as shown in Figure 6-53) mounting PCB4 on the operation panel sheet.

Art # A-05935

Figure 6-53: "B" side view of PCB4

10) Remove PCB4 and dust cover for control knob.

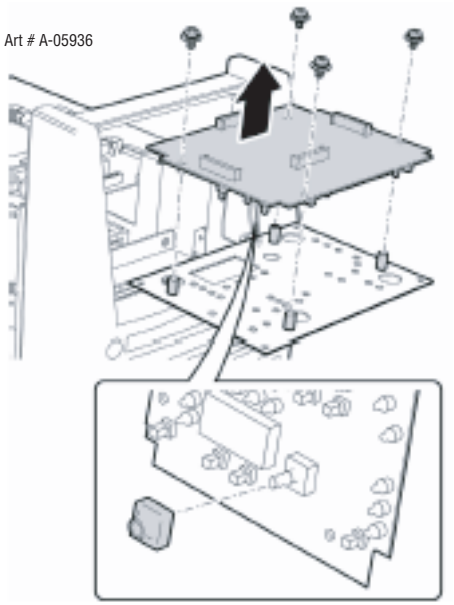



Figure 6-54: Removing PCB4

* When you reassemble the parts, conduct this process backwards.

## 6.15 PCB5 and PCB6 Replacement Procedure

Art # A-05927

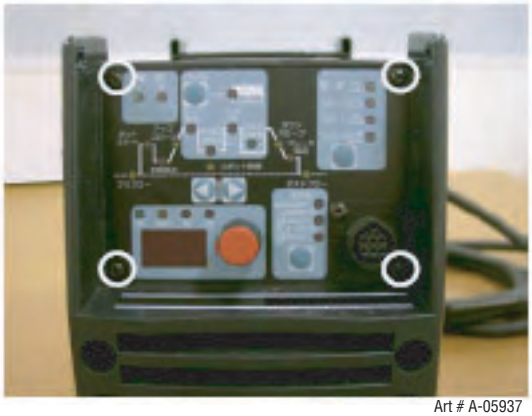
Figure 6-55: Power Source Front view

1) Remove the side covers. See section “6.01”.
2) Remove the protection panel cover over the front panel.
   * To remove the protection panel cover, push both edges of the cover in slightly, as indicated by left and right arrows in Figure 6-6-56, and pull up the cover frontward.

Art # A-05928

Figure 6-56: Protection Panel Cover

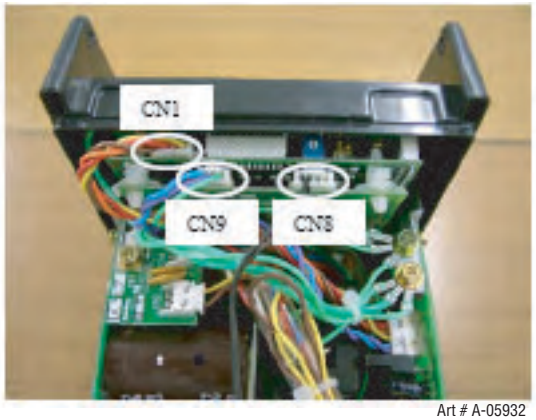
3) Remove the screws (4 places, circled as shown in Figure 6-57) holding the operation panel onto the front panel.



Art # A-05937

Figure 6-57: Operation Panel

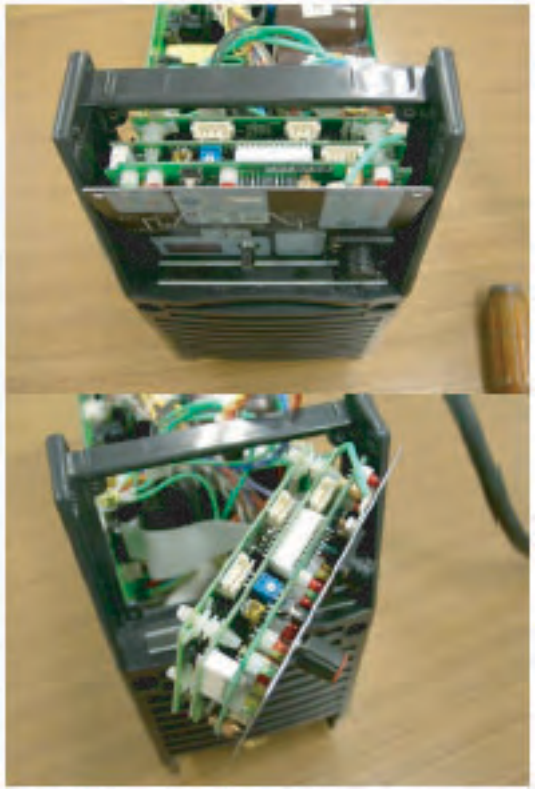
4) Unplug harness connectors (3 places, circled as shown in Figure 6-58) from CN1 on PCB5 and from CN8 and CN9 on PCB6.




Art # A-05932

Figure 6-58: Front side top view

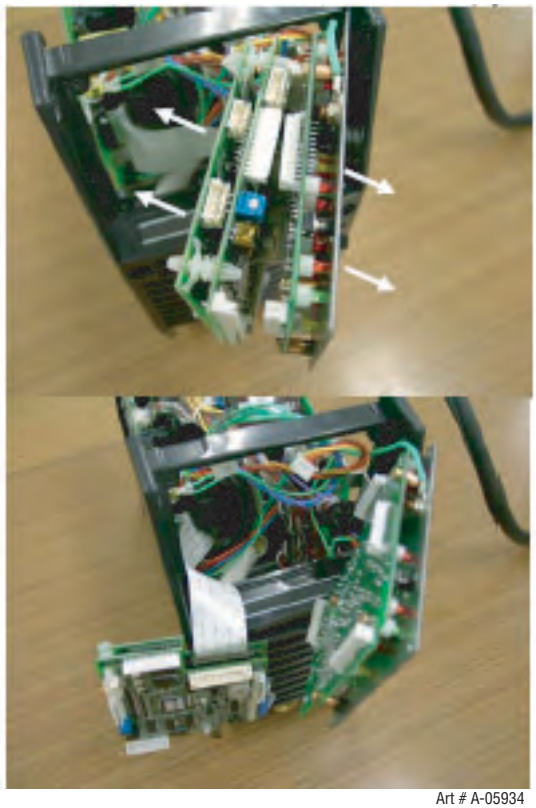
5) Pull the operation panel out of the front panel frontward.



Art # A-05933

Figure 6-59: Operation panel removed from front panel.

6) Disconnected and remove PCB5 and PCB6 from PCB4 by pulling the two PCB's apart.



Art # A-05934

Figure 6-60: Disassembling the operation panel.

7) Remove the retainer plugs (3 places, circled as shown in Figure 6-61) securing PCB5 to PCB6.

Art # A-05938

Figure 6-61: "B" side view of PCB6

8) Disconnect the flat ribbon cable (circled as shown in Figure 6-62) from PCB6 with PCB5 and PCB6 pulling open and away, as shown in Figure 6-62.

Art # A-05939

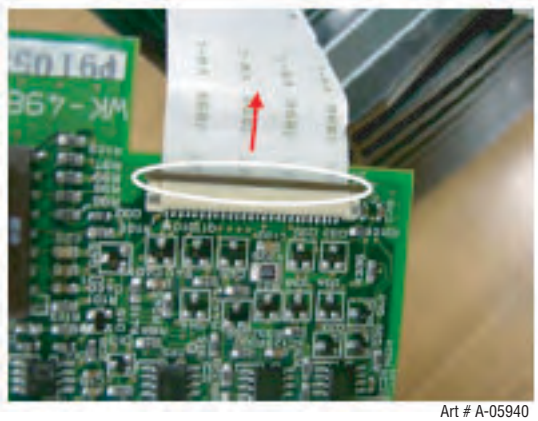
Figure 6-62: Flat Ribbon Cable on PCB6

9) Pull up the retainer bar securing the flat ribbon cable into CN5 (circled as shown in Figure 6-63)

10) Disconnected and remove PCB5 and PCB6 from PCB4 by pulling the two PCB's apart.

11) Disconnect the flat ribbon cable from CN5 connector by pulling straight up the cable.

12) When reconnecting the flat ribbon cable, make sure that it is oriented in such a manner that its wire-lead side portion is positioned on the backside, as shown in Figure 6-63.



Art # A-05940

Figure 6-63: CN5 on PCB6

* When you reassemble the parts, conduct this process backwards.

## 6.16 Switch, S1 Replacement Procedure

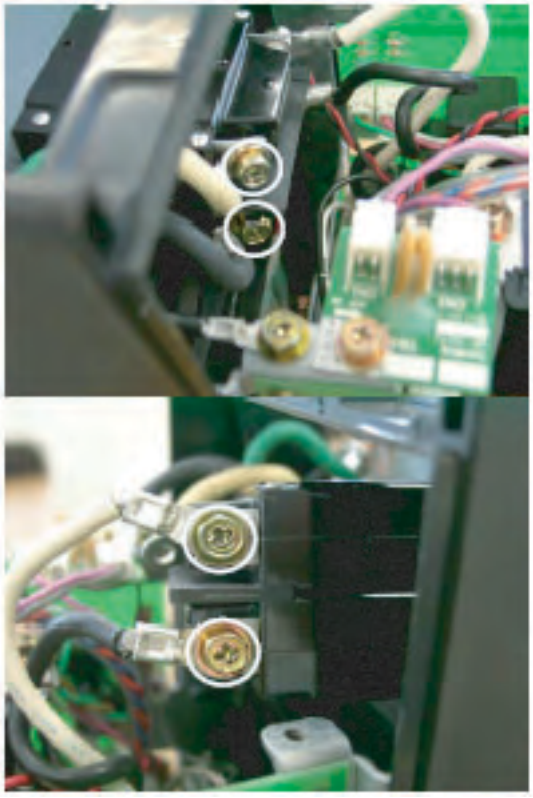
1) Remove the side covers. See section “6.01”.

2) Remove the screws (4 places, circled as shown in Figure 6-64) holding the rear panel.

Art # A-05941

Figure 6-64: Rear panel

3) Remove the screws (2 places for each, 4 places in total, circled as shown in Figure 6-65) from the switch along with four lug terminals.



Art # A-05942

Figure 6-65: Terminals on S1

4) Remove the two mounting screws and remove the switch.

Art # A-05943

Figure 6-66: Mounting Screws

* When you reassemble the parts, conduct this process backwards.

## 6.17 Semiconductor Diode, D1

### Test Procedure

1) Verify the characteristic of the diode, D1 on PCB1, using a diode tester.
2) Refer the Table 6-7 and Figure 6-67 for the test points on D1.

| COMPONENT TESTED | TERMINALS | | ACCEPTABLE VALUE |
|---|---|---|---|
| | Positive lead | Negative lead | |
| Diode of D1 | TB9 | TB10 | 0.3 to 0.5V |
| | TB10 | TB9 | Open circuit |
| Diode of D1 | TB10 | TB11 | 0.3 to 0.5V |
| | TB11 | TB10 | Open circuit |

Table 6-7: D1 Test points

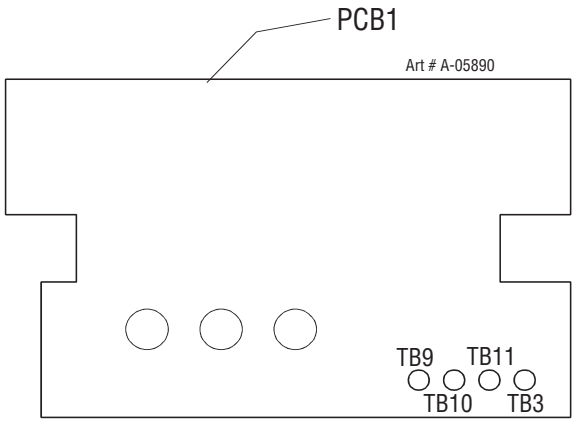



Figure 6-67: PCB1 view of checkpoints

### Replacement Procedure

1) Remove the side covers. See section “6.01”.
2) Remove PCB1. See section “6.12”.
3) Replace D1 together with PCB7.

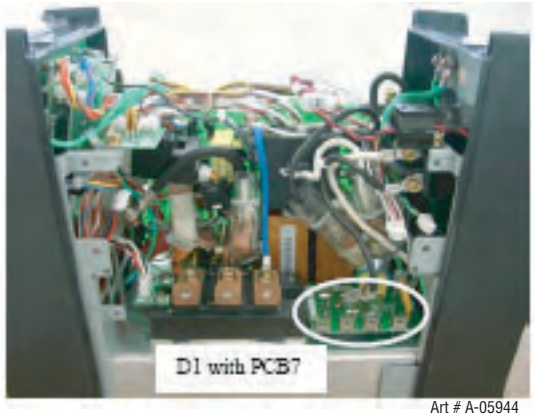
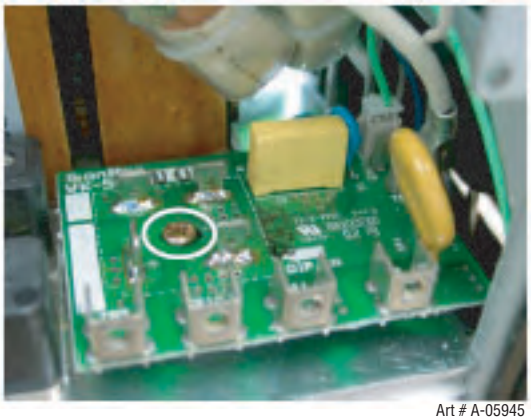



Figure 6-68: Location of PCB7 with D1

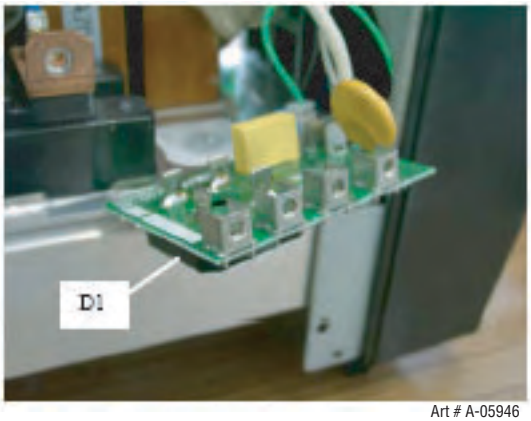
4) Remove the screw (circled as shown in Figure 6-69) securing PCB7 to heatsink.



Art # A-05945

Figure 6-69 Expanded view of PCB7

5) Pull out D1 together with PCB7 frontward.

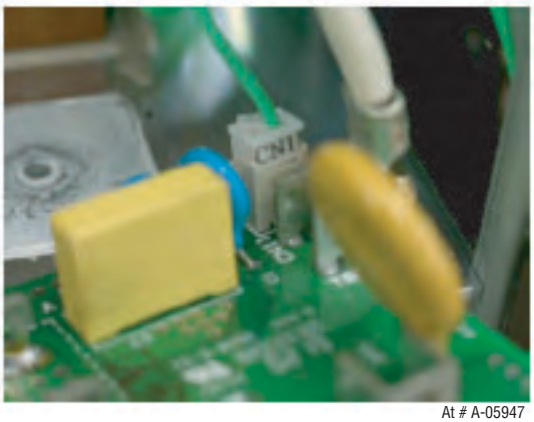



Art # A-05946

Figure 6-70: PCB7 and D1

6) Unplug a harness connector from CN1 on PCB7.

* Holding the upper portion of the harness (to unlock the contact between the harness connector and CN1), pull the harness lightly. To unplug the harness connector from CN1, do not pull the harness excessively.




At # A-05947

Figure 6-71: CN1 on PCB7

7) Remove the screw mounting the U-phase input cable lug on TB1 at PCB7, and remove the D1.

Art # A-05948

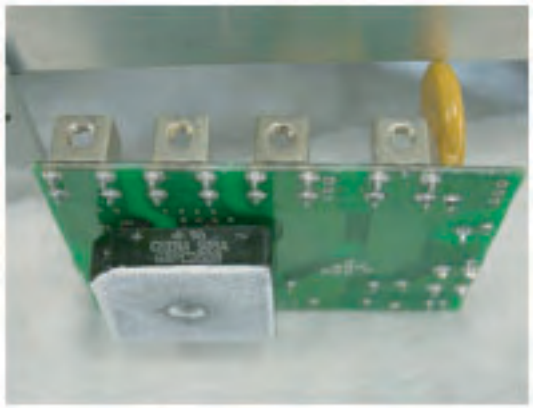
Figure 6-72: TB1 on PCB7

***NOTE***

*When you reassemble the parts, conduct this process backwards. Additionally, when installing the diode, apply 11.5 in. lb force to tighten the diode base screws and the terminal screws.*

***NOTE***

*When replacing the diode, apply heat sink compound (Shinetsu silicon G-747 or equivalent) uniformly to the base surface of the diode as shown in Figure 6-73.*



Art # A-05949

Figure 6-73: Base surface of D1

## 6.18 Semiconductor IGBT, Q1

### Test Procedure

1) Confirm there are no abnormal appearances on PCB3.
2) Verify the characteristic of the IGBT, Q1, using a diode tester.
3) Refer the Table 6-8 and Figure 6-74 for the test points on Q1.

| COMPONENT TESTED | TERMINALS | | ACCEPTABLE VALUE |
|---|---|---|---|
| | Positive lead | Negative lead | |
| Collector-Emitter of Q1 with PCB3 | C1<br>C2E1 | C2E1<br>C1 | Open circuit<br>0.2 to 0.5V |
| Collector-Emitter of Q1 with PCB3 | C2E1<br>E2 | E2<br>C2E1 | Open circuit<br>0.2 to 0.5V |

Table 6-8: Q1 test points

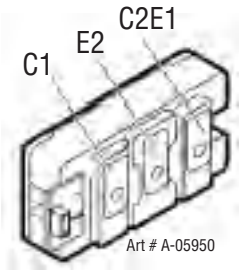



Figure 6-74: Q1 Test Points

### Replacement Procedure

1) Remove the side covers. See section “6.01”.
2) Remove PCB1. See section “6.12”.
3) Replace Q1 together with PCB3.

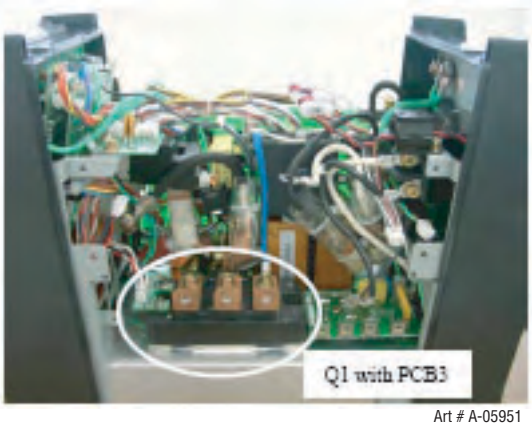



Figure 6-75: Location of Q1 with PCB3

4) Unplug a harness connector connected to PCB2 from CN1 on PCB3 (circled as shown in Figure 6-76).

Art # A-05952

Figure 6-76: CN3 on PCB3

5) Remove the screw mounting C1 on C2E1 on Q1 (circled as shown in Figure 6-77).

Art # A-05953

Figure 6-77: C2E1 on PCB3

6) Remove the two (2) screws securing Q1 to heatsink (circled as shown in Figure 6-78).

Art # A-05954

Figure 6-78: Q1 mounting screws.

7) Remove Q1 from the unit.

8) Remove the two Q bus bar1 mounted on C1 and E2 (circled as shown in Figure 6-79), and remove the IGBT.

Art # A-05955

Figure 6-79: Q bus bar1 on Q1

***NOTE***

*When replacing the IGBT, apply heat sink compound (Shinetsu silicon G-747 or equivalent) uniformly to the base surface of the diode as shown in Figure 6-80.*

Art # A-05956

Figure 6-80: Base surface of Q1

***NOTE***

*When you reassemble the parts, conduct this process backwards. Additionally, when install the IGBT, apply 27.44 in. lb force to the IGBT base screws and 2.6N.m to the terminal screws.*

## 6.19 Semiconductor Diode, D2, D3

### Test Procedure

1) Verify the characteristic of the diode, D2 and D3 using a diode tester.
2) Refer the Table 6-9 and Figure 6-81 for the test points on D2 (D3).

| COMPONENT TESTED | TERMINALS | | ACCEPTABLE VALUE |
|---|---|---|---|
| | Positive lead | Negative lead | |
| Diode1 of D2, D3 | Anode<br>Cathode | Cathode<br>Anode | 0.2 to 0.3V<br>Open circuit |
| Diode2 of D2, D3 | Anode<br>Cathode | Cathode<br>Anode | 0.2 to 0.3V<br>Open circuit |

Table 6-9: D2 and D3 test points

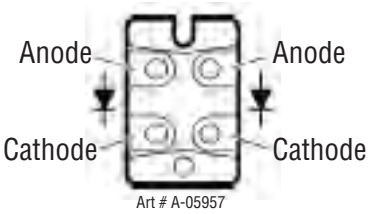



Figure 6-81: D2(D3) test points

### Replacement Procedure

1) Remove the side covers. See section “6.01”.
2) Remove PCB2. See section “6.13”.

Figure 6-82: Location of D2 and D3

3) Remove the screws (1 place for each, 2 places in total, circled as shown in Figure 6-83) mounting T1 on D2 and D3.

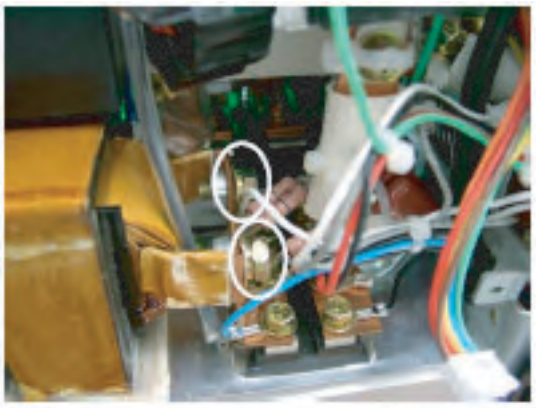



Figure 6-83: T1 mounting screws

4) Remove the screws mounting bus bars on and connecting snubber resistors to D2 and D3 (4 places for each, 8 places in total, circled as shown in Figure 6-84).

Art # A-05960

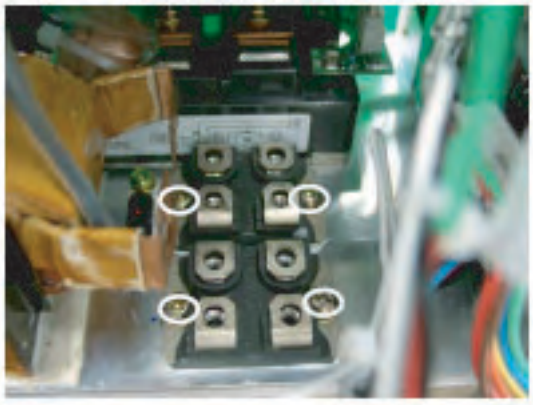
Figure 6-84: Screws mounting D2 and D3

5) Remove the mounting screws and then bus bars (circled as shown in Figure 6-85) from D2 and D3.

Art # A-05961

Figure 6-85: Bud bars on D2 and D3

6) Remove the screws securing D2 and D3 to heatsink (2 places for each, 4 places in total, circled as shown in figure 6-86), and remove the D2 and D3.



Art # A-05962

Figure 6-86: D2 and D3

Refer to ***NOTE*** on page 6-36

Art # A-05963

Figure 6-87: Base surface of D2(D3)

***NOTE***

*When you reassemble the parts, conduct the above process backwards. Additionally, when install the diode, apply 11.5in.lb force to the diode base screws. Pay attention to the direction of the diode when installing the diode.*

## 6.20 Thermistors, TH1

### Test Procedure

1) Select the Ohms scale on the digital meter.
2) Disconnect the connector at CN8 on PCB6.
3) The resistance of a good sensor measured between pins 1 and 2 on the connector should be in the 10kW to 21.6kW range, with the reading decreasing as the temperature of the power supply increases. A shorted reading indicates a bad sensor, and it should be replaced.

### Replacement Procedure

1) Remove the side covers. See section “6.01”.
2) Remove PCB2. See section “6.13”.
3) Remove the screw (circled as shown in Figure 6-88) securing TH1 to heatsink.

Art # A-05964

Figure 6-88: TH1

4) Unplug harness connector (circled as shown in Figure 6-89) from CN8 on PCB6, and remove the TH1.

Art # A-05965

Figure 6-89: Front side top view of CN8

***NOTE***

*When replacing the thermistors, apply heat sink compound (Shinetsu silicon G-747 or equivalent) uniformly to the base surface of the thermistors as shown in Figure 6-90.*

Art # A-05966

Figure 6-90: Base portion of TH1

* When you reassemble the parts, conduct this process backwards.

## 6.21 Coupling Coil, CC

### Test Procedure

1) Inspect the Coupling Coil, CC, for signs of overheating or loose connections.
2) Check for continuity through the coupling coil by measuring between both of the terminals.

### Replacement Procedure

1) Remove the side covers. See section “6.01”.
2) Remove the screws (4 places, circled as shown in Figure 6-91) from the front panel.

Art # A-05967

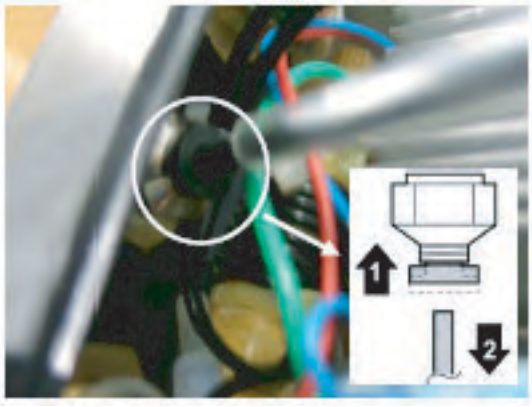
Figure 6-91: Power supply front view of panel screws.

3) Remove the screws holding the front panel and then the screws (2 places, circled as shown in Figure 6-92) mounting the output terminals.

Art # A-05968

Figure 6-92: Output terminal mounting screws.

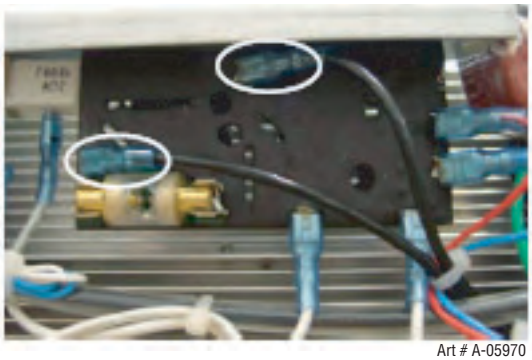
4) Unlock and remove the gas tube as shown in Figure 6-93.




Art # A-05969

Figure 6-93: Gas Tube

5) Disconnect the harnesses from CC1 and CC2 terminals by pulling up the harnesses lightly, as shown in Figure 6-94.



Art # A-05970

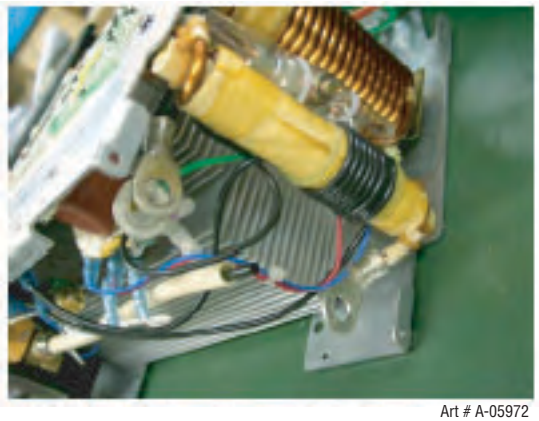
Figure 6-94: CC1 and CC2 on HF. UNIT

6) Remove the front panel from the chassis on the welding equipment.

Art # A-05971

Figure 6-95: Front panel bottom view.

7) Remove the insulating tube applied to the connection between CC and L1.



Art # A-05972

Figure 6-96: Internal front view.

8) Remove the insulating tube and then the screw connecting CC to L1 (circled as shown in Figure 6-97), and remove the CC.

Art # A-05973

Figure 6-97: Coupling Coil (CC)

* When you reassemble the parts, conduct this process backwards.

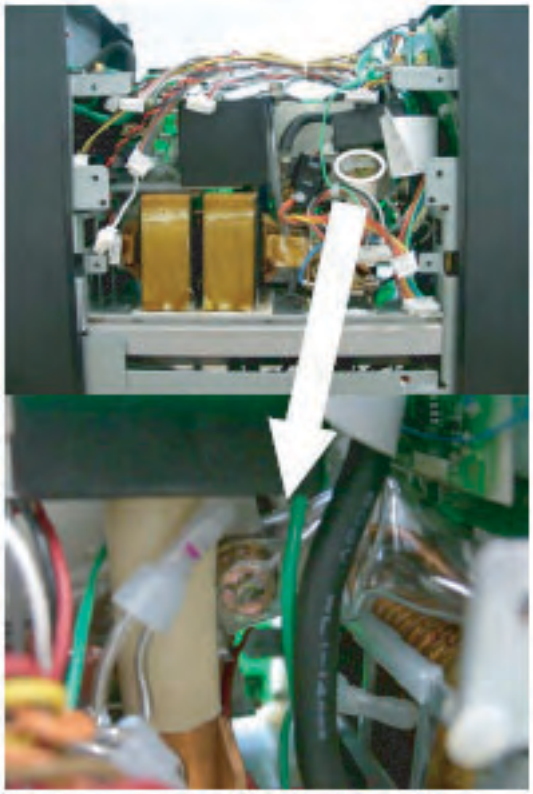
## 6.22 Reactor, L1

### Test Procedure

1) Inspect the Reactor, L1, for signs of overheating or loose connections.
2) Check for continuity through the Reactor by measuring between both of the terminals.

### Replacement Procedure

1) Remove the side covers. See section “6.01”.
2) Remove PCB2. See section “6.13”.
3) Remove the insulating tube applied to the connection between L1 and T1.



Art # A-05974

Figure 6-98: Insulating tube

4) Remove the screw connecting L1 to T1 (circled as shown in Figure 6-99).

ARt # A-05975

Figure 6-99: Screw connecting L1 to T1

5) Remove the screws (4 places, circled as shown in Figure 6-100) from the front panel.

Art # A-05967

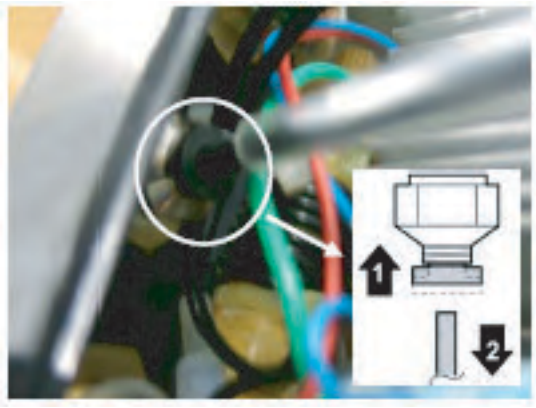
Figure 6-100: Power supply front view of 4 screws.

6) Remove the screws holding the front panel and then the bolts (2 places, circled as shown in Figure 6-101) mounting the output terminals.

Art # A-05968

Figure 6-101: Output terminal mounting screws.

7) Unlock and remove the gas tube as shown in Figure 6-102.




Art # A-05969

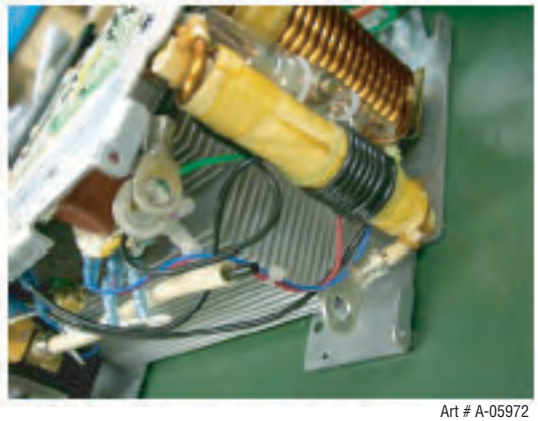
Figure 6-102: Gas Tube

8) Remove the front panel from the chassis on the welding equipment.

Art # A-05971

Figure 6-103: Front panel bottom view.

9) Remove the insulating tube applied to the connection between L1 and CC.



Art # A-05972

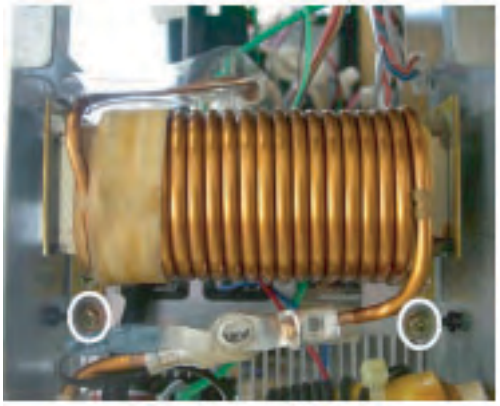
Figure 6-104: Internal front view

10) Remove the screw connecting L1 to CC (circled as shown in Figure 6-105).

Art # A-05973

Figure 6-105: L1 and CC

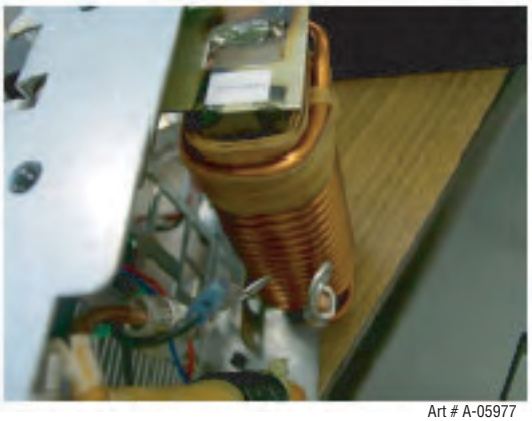
11) Remove the screws (2 places, circled as shown in Figure 6-106) mounting L1 on chassis.



Art # A-05976

Figure 6-106: L1

12) Pull L1 out of the welding equipment, as shown in Figure 6-107, and remove the L1.



Art # A-05977

Figure 6-107: Remove L1

* When you reassemble the parts, conduct this process backwards.

## 6.23 Transformer, T1

### Test Procedure

1) Inspect the Transformer, T1, for signs of overheating or loose connections.
2) Check for continuity across the primary windings of both transformers.
3) Check for continuity across the secondary windings of both transformers.
4) Check for insulation between the primary winding and the secondary winding of both transformers.

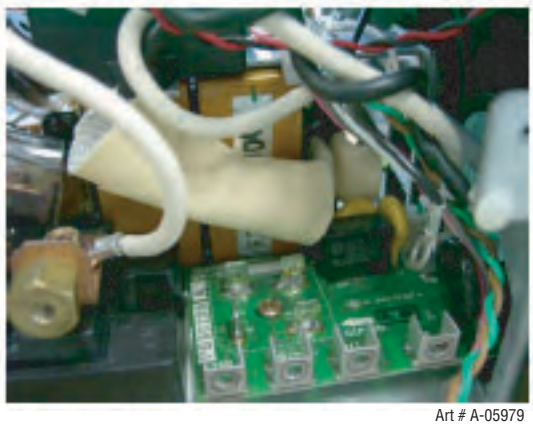
### Replacement Procedure

1) Remove the side covers. See section “6.01”.
2) Remove PCB1. See section “6.12”.

Art # A-05978

Figure 6-108: Internal view PCB1 side

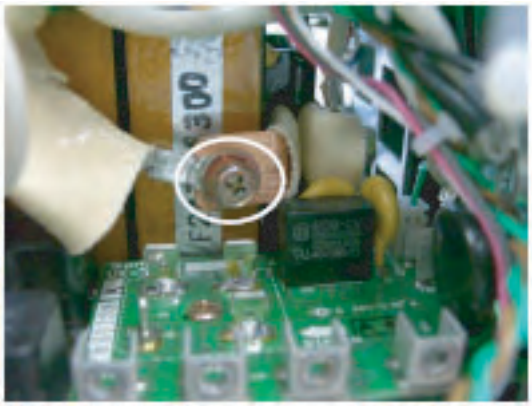
3) Remove the insulating tube applied to the connection between T1 and C1.



Art # A-05979

Figure 6-109: Insulating tube between T1 and C1

4) Remove the screw connecting T1 to C1 (circled as shown in Figure 6-110).



ARt # A-05980

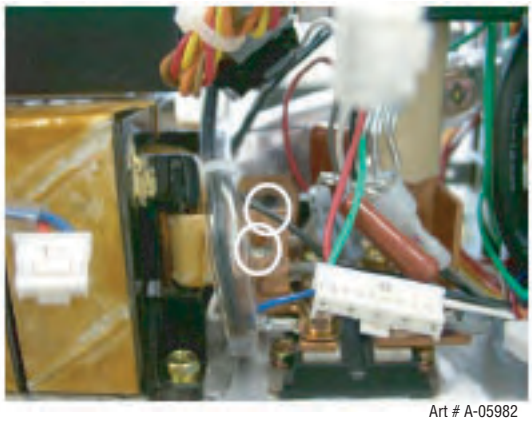
Figure 6-110: Screw connecting T1 to C1

5) Remove PCB2. See section 6.13.

Art # A-05981

Figure 6-111: Internal view PCB2 side.

6) Remove the screws (1 place for each, 2 places in total, circled as shown in Figure 112) mounting T1 on D2 and D3.



Art # A-05982

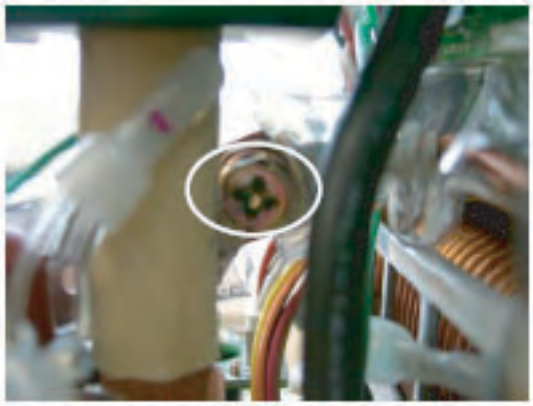
Figure 6-112: Mounting screw T1

7) Remove the insulating tube applied to the connection between L1 and T1.

ARt # A-05983

Figure 6-113: Insulating tube between L1 and T1

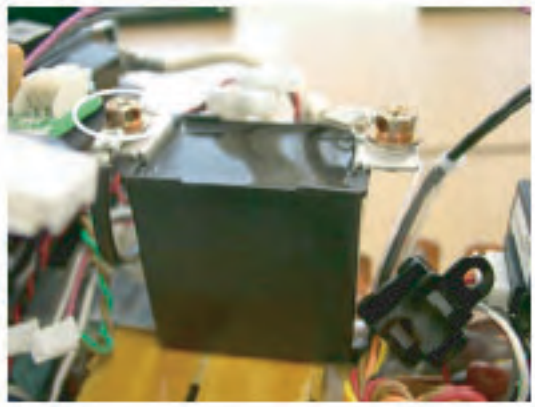
8) Remove the screw connecting L1 to T1 (circled as shown in Figure 114).



Art # A-05984

Figure 6-114: L1 to T1 connecting screw.

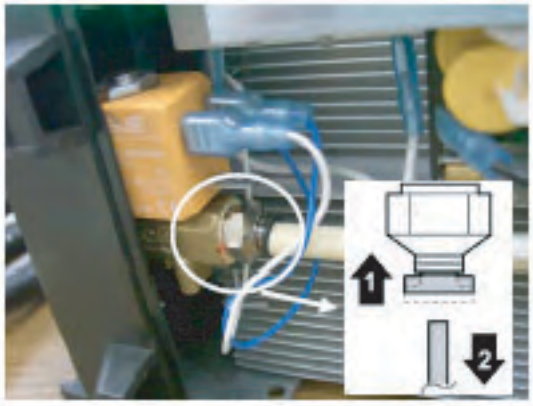
9) Remove the screw connecting C1 to E1C2 of Q1 (circled as shown in Figure 115).



Art # A-05985

Figure 6-115: C1

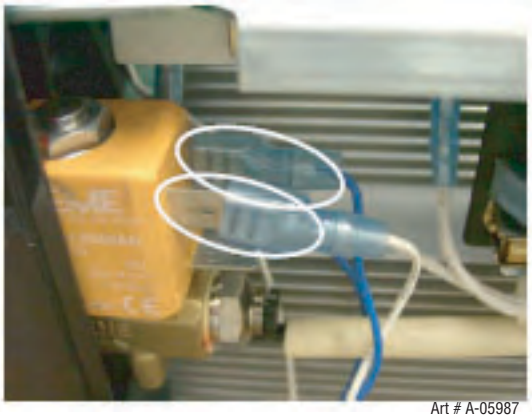
10) Unlock and remove the gas tube as shown in Figure 6-116.




Art # A-05986

Figure 6-116: Rear gas tube

11) Disconnect the harnesses from SOL terminals (circled as shown in Figure 6-117).



Art # A-05987

Figure 6-117: SOL terminals

12) Remove the screws (4 places, circled as shown in figure 6-118) securing chassis to the rear panel.

Art # A-05988

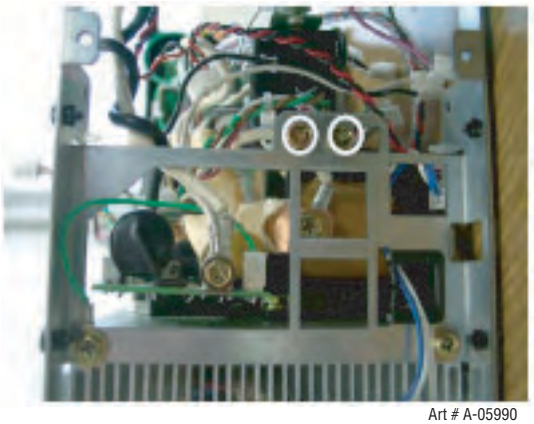
Figure 6-118: Rear panel screws

13) Remove the rear panel from the welding equipment.

Art # A-05989

Figure 6-119: Rear panel removed

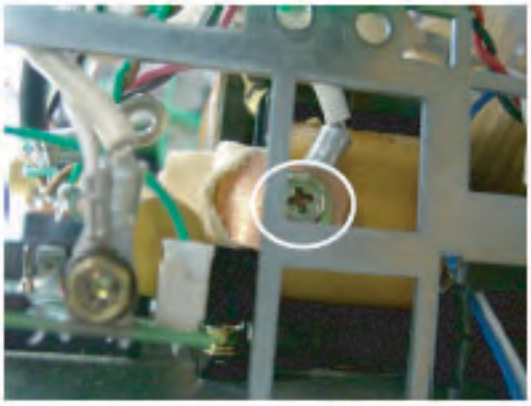
14) Remove the screws (2 places, circled as shown in Figure 6-120) mounting C1 on chassis.



Art # A-05990

Figure 6-120: C1 chassis mounting screws

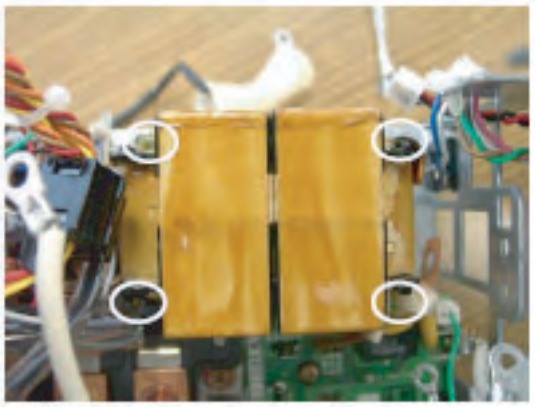
15) Remove the screw connecting T1 to TB6 of PCB1 (circled as shown in Figure 6-121).



Art # A-05991

Figure 6-121: Screw connecting T1 to TB6

16) Remove the screws (4 places, circled as shown in Figure 6-122) mounting T1 on chassis, and remove the T1.



Art # A-05992

Figure 6-122: Removing T1

* When you reassemble the parts, conduct this process backwards.

## 6.24 Hall Current Transformer (HCT), CT1

### Test Procedure

1) Remove the locking connector CN7 attached to PCB2.

2) With an Ohmmeter set the R´10 scale, measure between the pins on the CN7 plug as follows:

   Pin 4 and Pin 1 about 3 to 5 MW

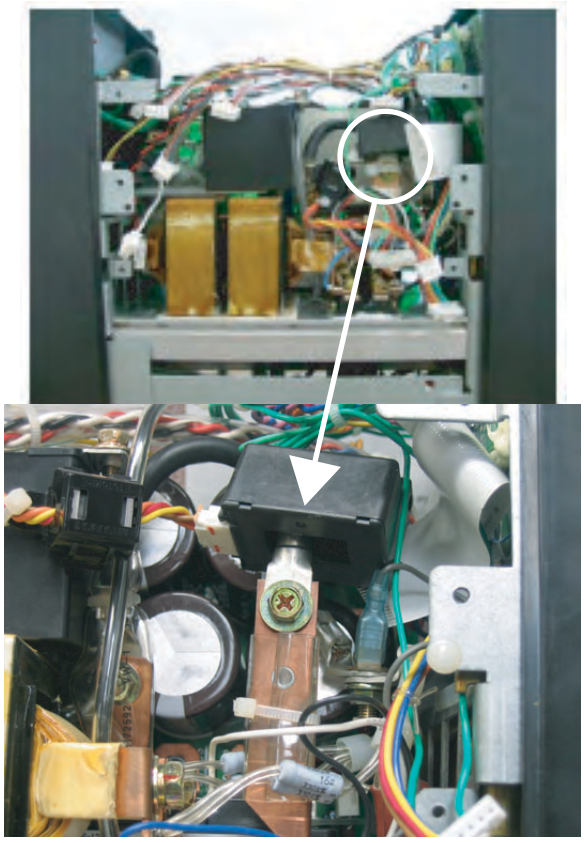
   Pin 4 and Pin 2 about 10 kW

### Replacement Procedure

1) Remove the side covers. See section “6.01”.

2) Remove PCB2. See section "6.13".

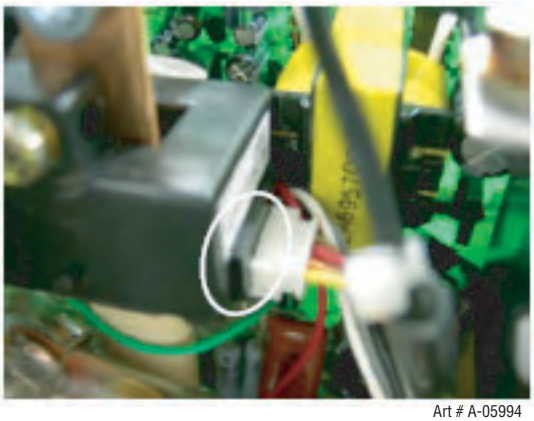
3) Remove the screw (circled as shown in Figure 6-123) connecting L1 to the diode bus bar on D2 and D3.



Art # A-05993

Figure 6-123: Screw connecting L1 to diode bus bar

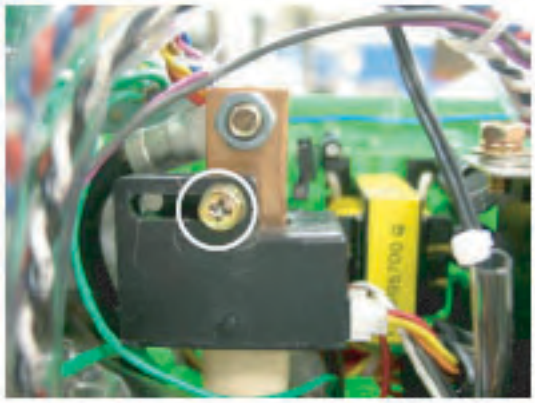
4) Unplug the harness connector from CT1 (from CN7 on PCB2) (circled as shown in Figure 6-124).



Art # A-05994

Figure 6-124: Harness connector on CT1

5) Remove the screw (circled as shown in Figure 125) mounting CT1 on the diode bus bar on D2 and D3, and remove the CT1.

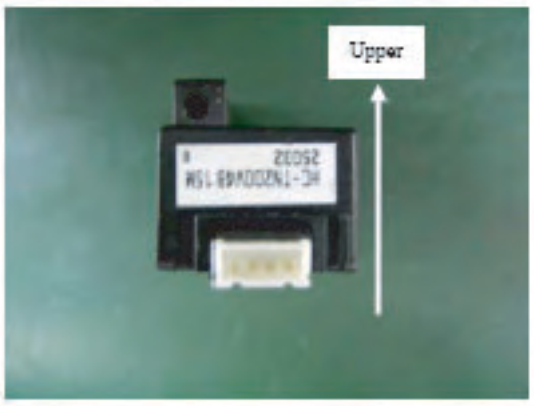


Art # A-05995

Figure 6-125: Diode bus bar and screw mounting CT1

***NOTE***

*When you reassemble the parts, conduct this process backwards. When installing CT1, be sure to orient it, as shown in Figure 6-126.*

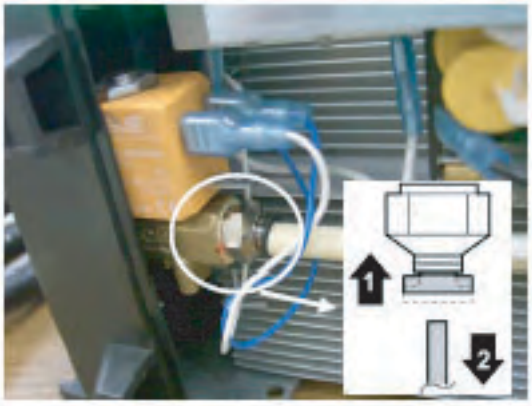



Art # A-05996

Figure 6-126: Orientation of CT1

## 6.25 FAN1 Replacement Procedure

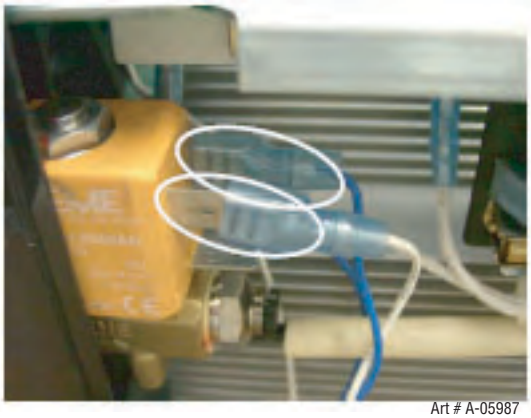
1) Remove the side covers. See section “6.01”.
2) Unlock and remove the gas tube as shown in Figure 6-127.




Art # A-05986

Figure 6-127: Removing gas tube in rear

3) Disconnect the harnesses from SOL terminals (circled as shown in Figure 6-128).



Art # A-05987

Figure 6-128: SOL terminals

4) Remove the screws (4 places, circled as shown in Figure 6-129) securing chassis to the rear panel.

Art # A-05988

Figure 6-129: Rear panel screws.

5) Remove the rear panel from the welding equipment.

Art # A-05989

Figure 6-130: Removing rear panel.

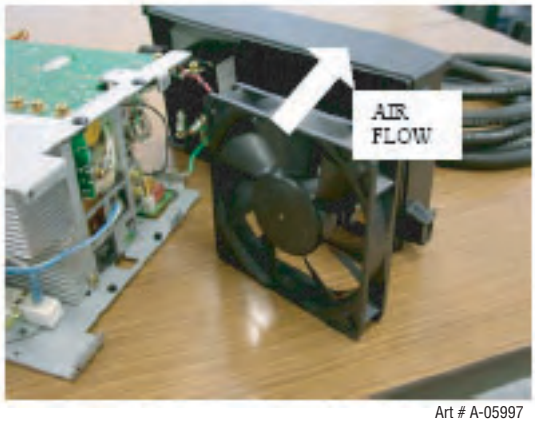
6) Unplug the harness connector from CN3 on PCB2, and remove the FAN1.

Art # A-05917

Figure 6-131: CN3 on PCB2

***NOTE***

*When you reassemble the parts, conduct the above process backwards. When installing FAN1, be sure to orient it, as shown in Figure 6-132.*

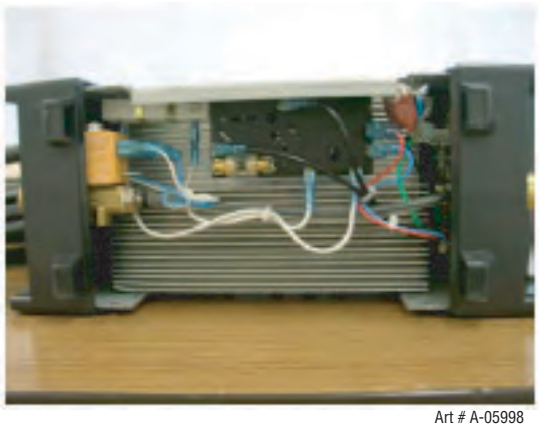



Art # A-05997

Figure 6-132: FAN1 orientation.

## 6.26 HF. UNIT Replacement Procedure

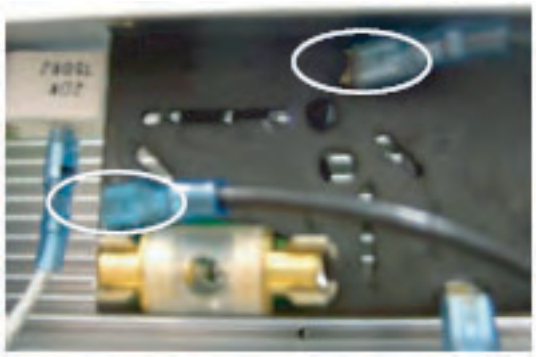
1) Remove the side covers. See section “6.01”. Turn power source onto side.



Art # A-05998

Figure 6-133: Welding equipment bottom view.

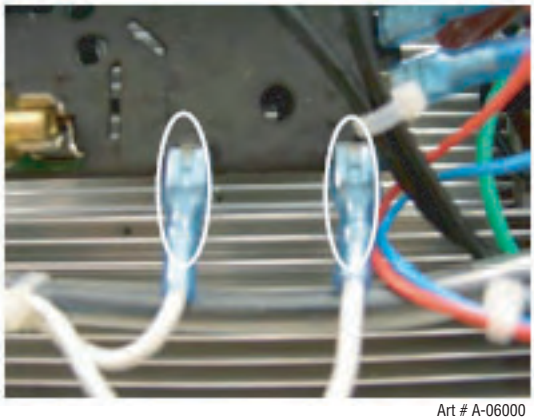
2) Disconnect the harnesses from HF coupling coil (CC) terminals (CC1 and CC2 terminals, circled as shown in Figure 6-134).



Art # A-05999

Figure 6-134: CC1 and CC2 on HF. UNIT

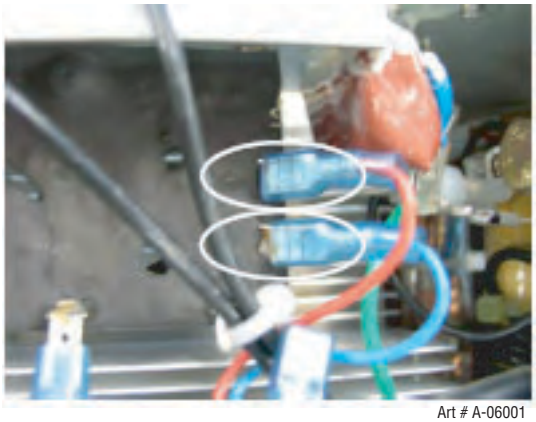
3) Disconnect the harnesses from HF. UNIT resistor (R2) terminals (R1 and R2 terminals, circled as shown in Figure 6-135).



Art # A-06000

Figure 6-135: R1 and R2 on HF. UNIT

4) Disconnect the harnesses from the terminals on the Welding Power Source side (AC1 and AC2 terminals, circled as shown in Figure 6-136).



Art # A-06001

Figure 6-136: AC1 and AC2 on HF. UNIT

5) Remove the screws (circled as shown in Figure 6-137) mounting HF.UNIT on chassis.

Art # A-06002

Figure 6-137: HF. UNIT mounting screws.

6) Remove HF.UNIT from the chassis on the welding equipment, and Pull up and remove GAP mounted on HF.UNIT, as shown in Figure 6-138.

Art # A-06003

Figure 6-138: HF. UNIT and GAP

* When you reassemble the parts, conduct this process backwards.

## 6.27 Current-limiting Resistor for HF.UNIT, R2

### Test Procedure

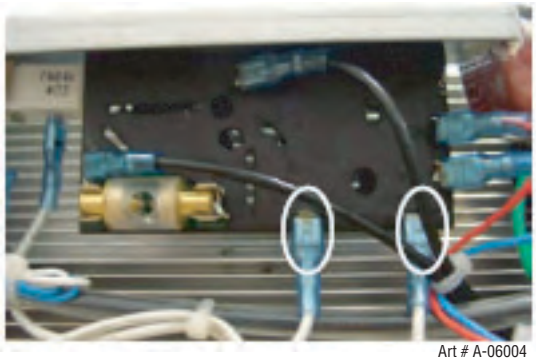
1) Inspect the Resistor, R2, for signs of overheating or loose connections.

2) With an Ohmmeter set the R´1 scale, measure between both of the terminals as about 150W.

### Replacement Procedure

1) Remove the side covers. See section “6.01”.

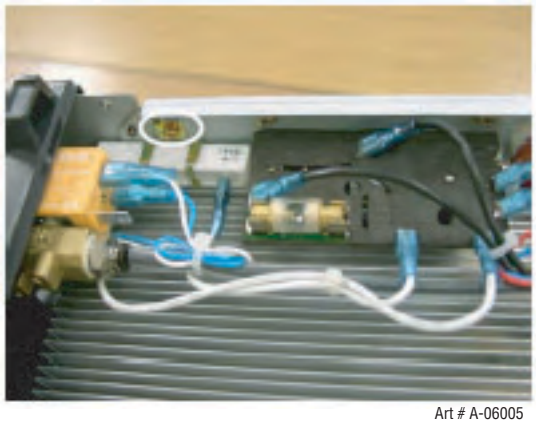
2) Unplug the harnesses from HF. UNIT resistor (R2) terminals (R1 and R2 terminals, circled as shown in Figure 6-139).



Art # A-06004

Figure 6-139: Expanded bottom view

3) Remove the screw (circled as shown in Figure 6-140) mounting R2 on chassis, and remove R2.



Art # A-06005

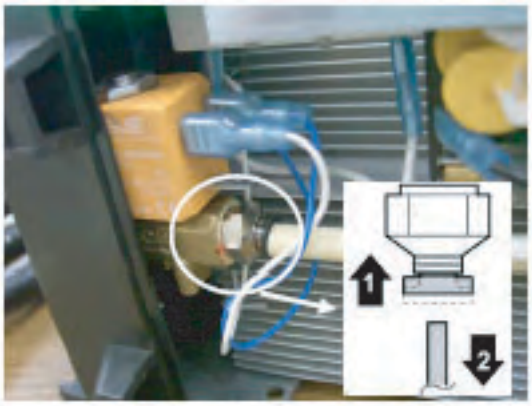
Figure 6-140: R2 mounting screw.

* When you reassemble the parts, conduct the above process backwards.

## 6.28 Gas Valve, SOL Replacement Procedure

1) Remove the side covers. See section "6.01".

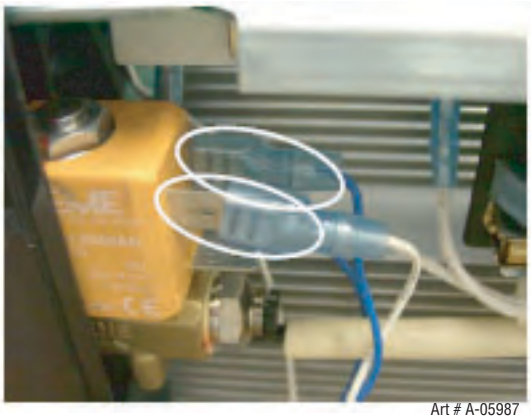
2) Unlock and remove the gas tube as shown in Figure 6-141.




Art # A-05986

Figure 6-141: Gas tube rear

3) Disconnect the harnesses from SOL terminals (circled as shown in Figure 6-142).



Art # A-05987

Figure 6-142: SOL terminals

4) Remove the C ring of the gas valve at the rear frame using C-ring pliers, and remove the SOL.

Art # A-06006

Figure 6-143: Gas valve

* When you reassemble the parts, conduct this process backwards.

# SECTION 7: PARTS LIST

## 7.01 Equipment Identification

All identification numbers as described in the Introduction chapter must be furnished when ordering parts or making inquiries. This information is usually found on the nameplate attached to the equipment. Be sure to include any dash numbers following the Specification or Assembly numbers.

## 7.02 How To Use This Parts List

The Parts List is a combination of an illustration and a corresponding list of parts which contains a breakdown of the equipment into assemblies, subassemblies, and detail parts. All parts of the equipment are listed except for commercially available hardware, bulk items such as wire, cable, sleeving, tubing, etc., and permanently attached items which are soldered, riveted, or welded to other parts. The part descriptions may be indented to show part relationships.

To determine the part number, description, quantity, or application of an item, simply locate the item in question from the illustration and refer to that item number in the corresponding Parts List.

**SPEC NUMBERS:**

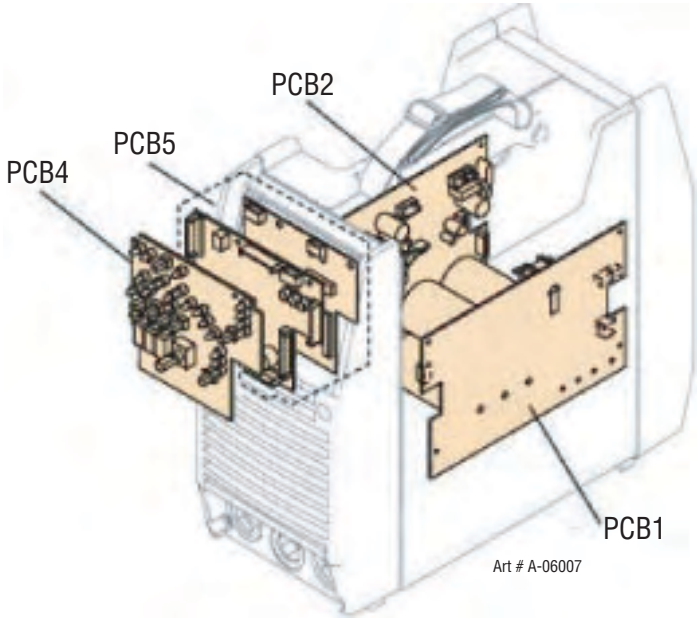
| | |
|---|---|
| **P-Wee 160TS** | **100085** |

## 7.03 Parts List

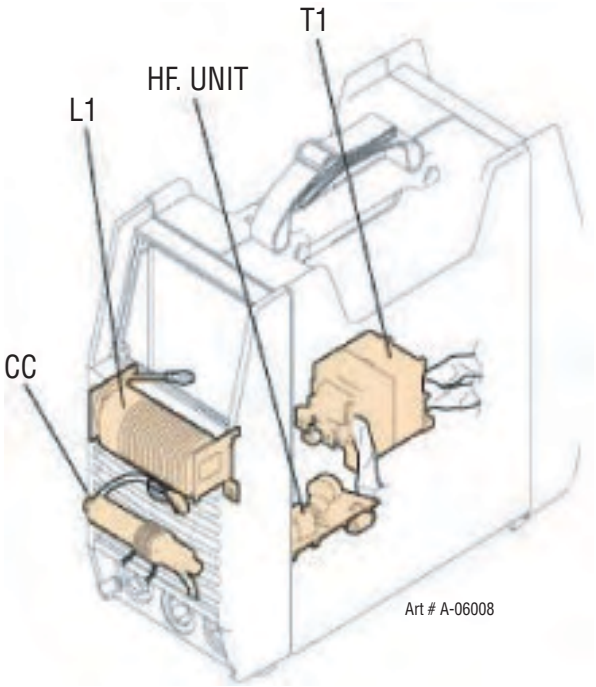
| DWG. No. | Description | Type & Rating | QTY. | Code No. | Order No. |
|---|---|---|---|---|---|
| C1 | Capacitor | SS351206PPQ1 DC 350V 20uF | 1 | 42601003900 | 10-6685 |
| C2** | Capacitor | ECKATS103MF 0.01uF | 1 | 42442007100 | 10-2219 |
| C3** | Capacitor | ECKATS103MF 0.01uF | 1 | 42442007100 | 10-2219 |
| C4** | Capacitor | ECW-H10H683JR DC1KV 0.068uF | 1 | 42421138500 | 10-5013 |
| C5-6** | Capacitor | ECW-H12H472JR 1200V .0047uF | 2 | 42421141100 | 10-2216 |
| CC | Coupling Coil | F2A696800 CC | 1 | F2A696800 | 10-6727 |
| CON1 | Remote Socket | 206433-1 8P | 1 | U0A706200 | 10-6838 |
| | | (with Wiring Assembly) | | | |
| CT1 | Current Sensor | HC-TN200V4B15M 200A 4V | 1 | 11251003000 | 10-5003 |
| D1 | Diode | GBPC3508 800V 35 | 1 | 44913000100 | 10-6686 |
| D2-3 | Diode | DBA200UA40 | 2 | 4582A0040 | 10-6687 |
| FAN1 | Fan | D12T24PS101 DC 24V w/harness protection | 1 | U0A738100 | 10-6840 |
| HF.UNIT | H. F. Unit | H. F. UNIT | 1 | U0A632200 | 10-6632 |
| | H. F. Gap | U0A601100 | 1 | U0A601100 | 10-6633 |
| L1 | Inductor | F2A677500 FCH | 1 | F2A677500 | 10-6728 |
| L104 | Inductor | 1615MRE RING CORE | 1 | 63200006500 | 10-6538 |
| L105 | Inductor | 1615MRE RING CORE | 1 | 63200006500 | 10-6538 |
| L106 | Inductor | 1615MRE RING CORE | 1 | 63200006500 | 10-6538 |
| PCB1 | Printed Circuit Board | WK-4980 U01 MAIN2 With Thunder Label | 1 | U0A706300 | 10-6689 |
| PCB2 | Printed Circuit Board | WK-4977 U01 MAIN1 with Thunder Label | 1 | U0A706400 | 10-6690 |
| PCB4 | Printed Circuit Board | WK-4985 U06 DCTIG PANEL | 1 | P0A498506 | 10-6729 |
| PCB5 | Printed Circuit Board | WK-4986 U01 CNTL1 | 1 | P0A498601 | 10-6692-1 |
| PCB6 | Printed Circuit Board | WK-4987 U01 CNTL2 | 1 | P0A498701 | 10-6693 |
| PCB7 | Printed Circuit Board | WK-5015 U01 DIODE PCB | 1 | P0A501501 | 10-6694 |
| PCB8 | Printed Circuit Board | WK-5071 U01 CONNECT PCB | 1 | P0A507101 | 10-6695 |
| PCB9 | Printed Circuit Board | WK-5336 DIODE SNUBBER | 1 | P0A533600 | 10-6920 |
| PCB10 | Printed Circuit Board | WK-5358 OUTPUT FILTER | 1 | P0A535800 | 10-6921 |
| Q1 | Transistor | CM100DUS12F-2 600V 100A (with WK-3367 U04) | 1 | U0A706500 | 10-6696 |
| R1 | Resistor | ERG-3ANJ 472 3W 4.7KOhm | 1 | 40305147200 | 10-5010 |
| R2 | Resistor | ERF20HMJ151 20W 150Ohm | 1 | 40310211500 | 10-5081 |

| DWG. No. | Description | Type & Rating | QTY. | Code No. | Order No. |
|---|---|---|---|---|---|
| R3A | Resistor | ERG3SJ330 3W 33Ohm | 1 | 40305010100 | 10-6697 |
| R3B | Resistor | ERG3SJ330 3W 33Ohm | 1 | 40305010100 | 10-6697 |
| R4A | Resistor | ERG3SJ330 3W 33Ohm | 1 | 40305010100 | 10-6697 |
| R4B | Resistor | ERG3SJ330 3W 33Ohm | 1 | 40305010100 | 10-6697 |
| R5 | Resistor | ERG-3ANJ 103 3W 10KOhm | 1 | 40305110300 | 10-5009 |
| S1 | Switch | DCP-52SR50C-480V 2P-480V | 1 | 25850003500 | 10-6644 |
| SOL1 | Solenoid Valve | 5505NBR1.5 DC24V 11VA/10W (with Gas Inlet and PC4-02) | 1 | U0A705700 | 10-6645 |
| T1 | Transformer | F2A704300 | 1 | F2A704300 | 10-6698 |
| TH1 | Thermistor | ERTA53D203 20K"/25° C B=3950K w/harness protection | 1 | U0A733200 | 10-6841 |
| | Front Panel | E0D004500 | 1 | E0D004500 | 10-6699 |
| | Rear Panel | E0D004600 | 1 | E0D004600 | 10-6700 |
| | Side Panel | E0D006000 | 2 | E0D006000 | 10-6701 |
| | Front Control Cover | J4B515400 | 1 | J4B515400 | 10-6702 |
| | Rear Control Cover | JDA111800 (with Label) | 1 | U0A706600 | 10-6730 |
| | Protection Cover | E1B500700 | 1 | E1B500700 | 10-6704 |
| | Encoder Cover | EBA514400 | 1 | EBA514400 | 10-6654 |
| | PCB Cover | E1B550900 (with Caution Label) | 1 | U0A706700 | 10-6705 |
| | Strap | E5A937000 | 1 | E5A937000 | 10-5069 |
| | Name Label | N4A007400 | 2 | N4A007400 | 10-6731 |
| | “VRD INSIDE” Label | N4A155900 | 1 | N4A155900 | Ref. Only |
| | VRD Caution Label | N4A598700 | 1 | N4A598700 | 23X4915 |
| | Primary Power Hook-Up Label | N4A598200 | 1 | N4A598200 | 23X4914 |
| | Side Label | N4A009100 | 2 | N4A009100 | 10-6707 |
| | Warning Label 1 | N4A072400 | 1 | N4A072400 | 10-6708 |
| | Warning Label 2 | N4A072500 | 1 | N4A072500 | 10-6709 |
| | Output Terminal Label | N4A040000 | 1 | N4A040000 | 10-6732 |
| | Gas Input Label | N4A040700 | 1 | N4A040700 | 10-6733 |
| | Gas Outlet | EBA077600 (with PC4-02) | 1 | U0A705800 | 10-6659 |
| | C-Ring | | 2 | 53003000600 | 10-5184 |
| | Output Terminal (female) | TRAK-BE10-25 | 2 | 26999025700 | 10-6711 |

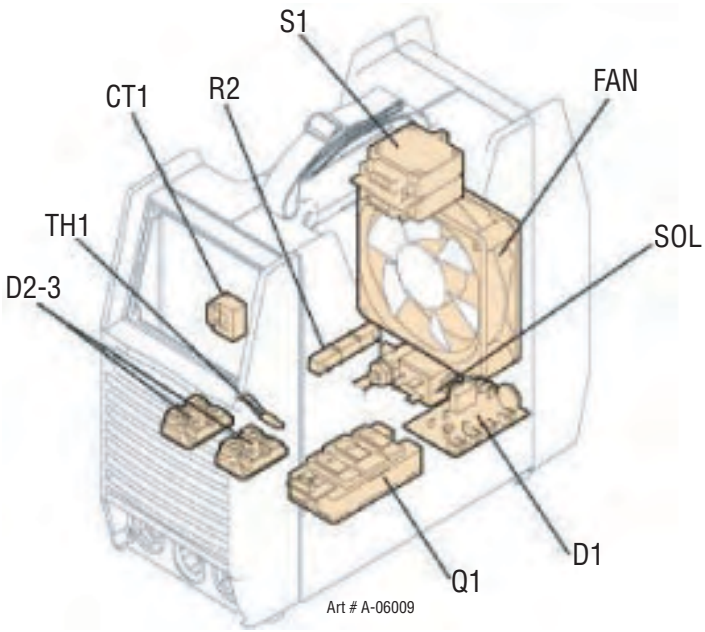
| DWG. No. | Description | Type & Rating | QTY. | Code No. | Order No. |
|---|---|---|---|---|---|
| | Input Cable | 132” 12/3 SOOW BLK W/5-15P | 1 | 52031130100 | N/A |
| | Input Cable | 132” 10/3 SOOW BLK 1 | 1 | U0A815200 | N/A |
| | Input Cable Clamp | SCLB18A | 1 | 53613021800 | 10-6712 |
| | Input Cable Clamp | N/A 1 | 1 | N/A | N/A |
| | Heatsink | E1B575400 | 1 | E1B575400 | 10-6713 |
| | Knob | 2615603 | 1 | 50990001500 | 10-6714 |
| | Knob Cap | 3015104 | 1 | 50990003500 | 10-6715 |
| | Control Cover Sheet | N0B882100 | 1 | N0B882100 | 10-6734 |
| | Flat Cable(Long) | EAA547301 | 1 | EAA547301 | 10-6668 |
| | Flat Cable(Short) | EBA420200 | 1 | EBA420200 | 10-6717 |
| | Q-Post(M5) | EBA436000 | 1 | EBA436000 | 10-6674 |
| | D-T Bus Bar | EBA447900 | 2 | EBA447900 | 10-6718 |
| | Q Bus Bar1 | EBA448200 | 2 | EBA448200 | 10-6719 |
| | Q Bus Bar2 (C2E1) | EBA551900 | 1 | EBA551900 | 10-6720 |
| | Diode Bus Bar | EBA508300 | 1 | EBA508300 | 10-6721 |
| | Clip | #74 NATURAL | 4 | 60602422000 | 10-5259 |
| | Front Chassis | J3C009200 | 1 | J3C009200 | 10-6722 |
| | Rear Chassis | J3C010800 | 1 | J3C010800 | 10-6723 |
| | Capacitor Chassis | JDA117700 | 1 | JDA117700 | 10-6724 |
| | HF Unit Chassis | J4B549700 | 1 | J4B549700 | 10-6725 |
| | Nylon Hose | T0425B Nylon Hose L=0.5m | 1 | U0A706000 | 10-6681 |
| | Output Terminal (male) | TRAK-SK10-25 | 2 | 26999025600 | 10-1068 |
| | Operating Manual | | 1 | | 430429-505 |
| | Service Manual | | | | 0-4754 |




Art # A-06007



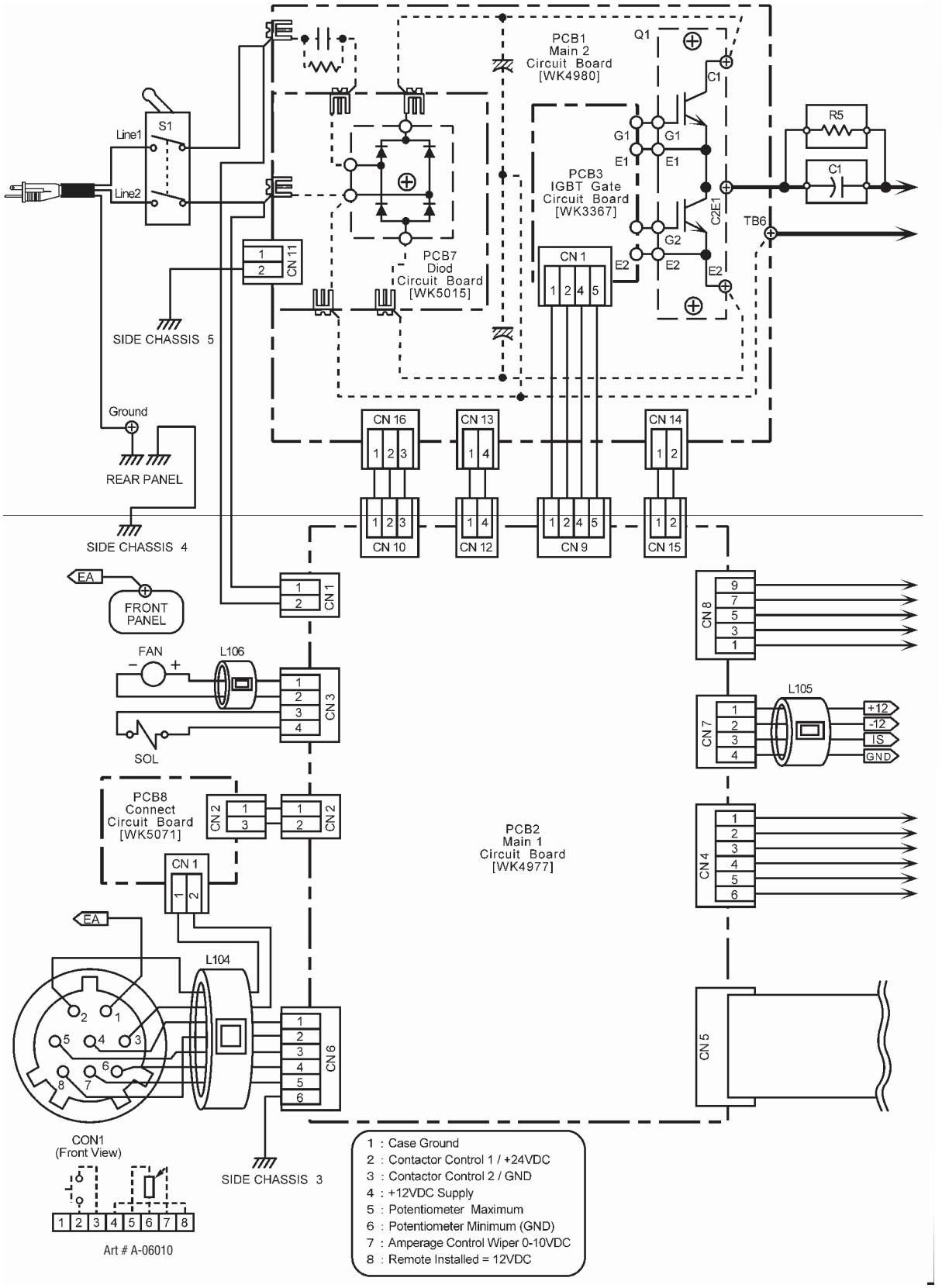

Art # A-06008

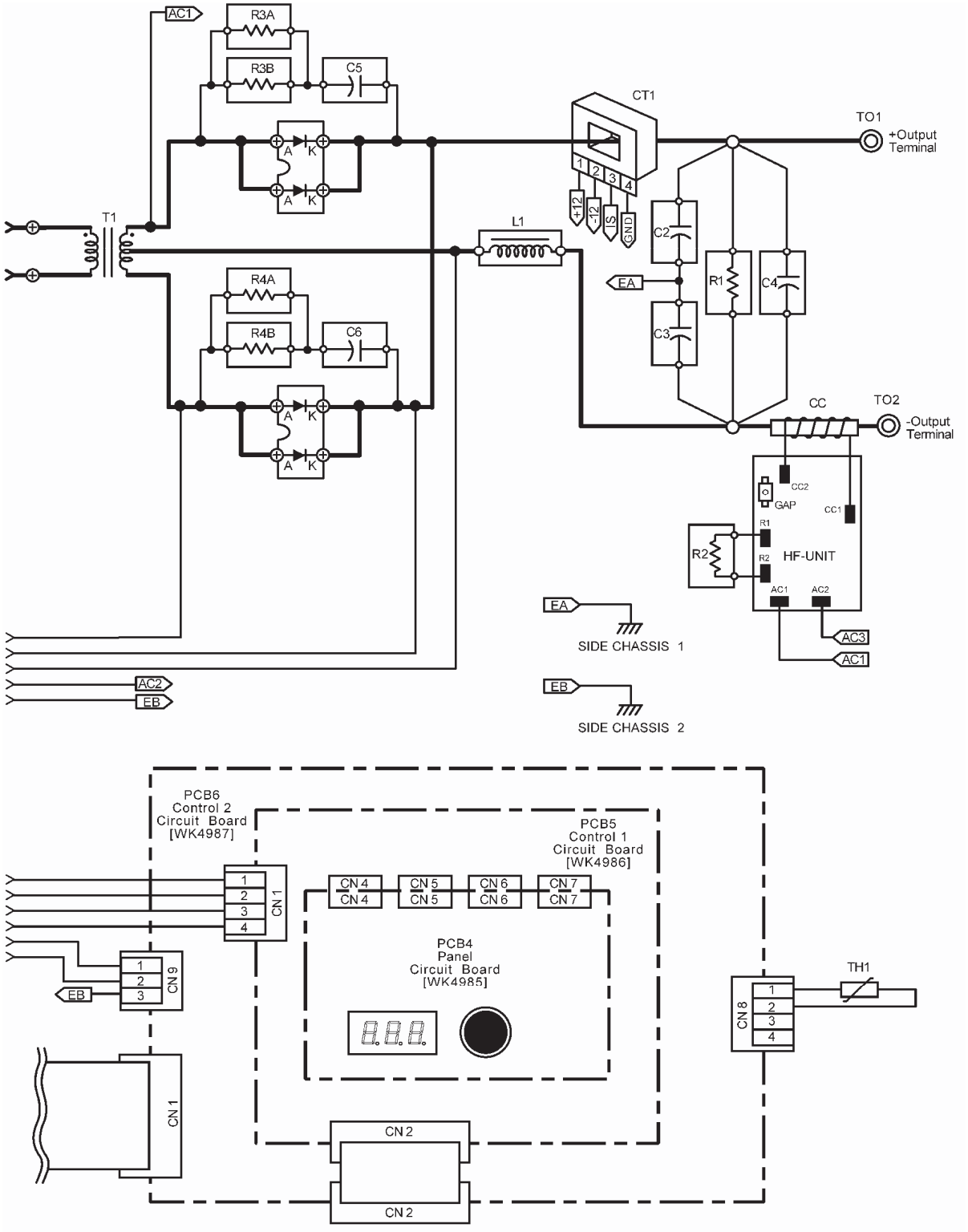

S1
CT1
R2
FAN
TH1
SOL
D2-3
D1
Q1
Art # A-06009

# APPENDIX 1: GENERAL INFORMATION

- Note the model and specification number shown on the equipment nameplate.

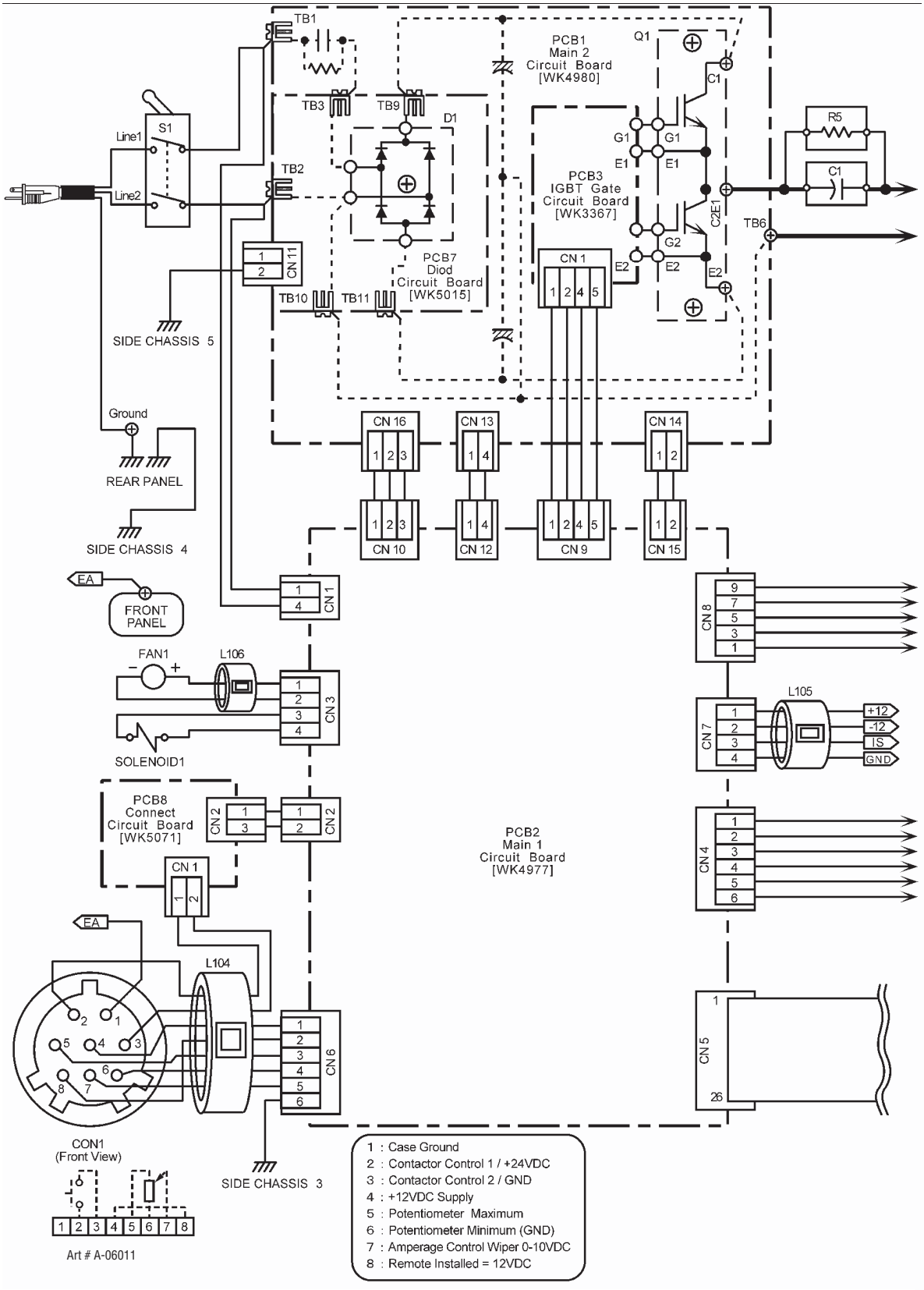
# APPENDIX 2: INTERCONNECT DIAGRAM SERIAL NUMBERS XXXXXXA AND EARLIER

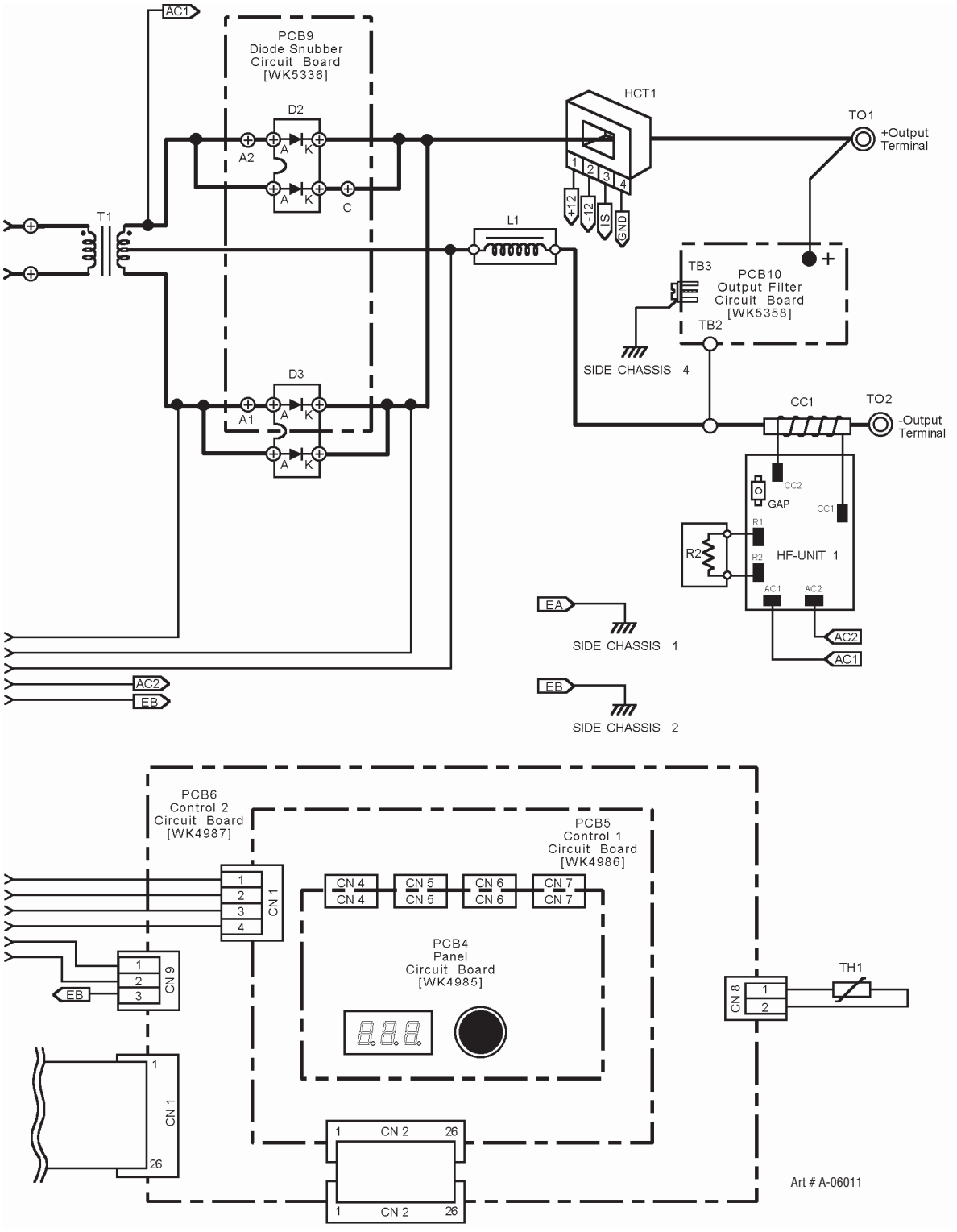



AC1
R3A
R3B
C5
CT1
TO1
+Output Terminal
T1
L1
+12
-12
IS
GND
C2
R1
C4
C3
EA
R4A
R4B
C6
CC
TO2
-Output Terminal
CC2
GAP
CC1
R1
R2
HF-UNIT
R2
AC1
AC2
AC3
AC1
EA
SIDE CHASSIS 1
EB
SIDE CHASSIS 2
AC2
EB
PCB6
Control 2
Circuit Board
[WK4987]
PCB5
Control 1
Circuit Board
[WK4986]
CN 1
CN 4
CN 5
CN 6
CN 7
PCB4
Panel
Circuit Board
[WK4985]
CN 9
EB
TH1
CN 8
CN 1
CN 2
CN 2

Art # A-06010

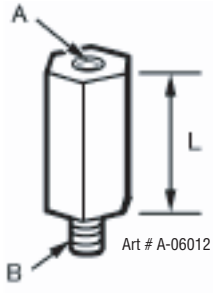
# APPENDIX 3: INTERCONNECT DIAGRAM SERIAL NUMBERS XXXXXXA103067 AND LATER




AC1
PCB9
Diode Snubber
Circuit Board
[WK5336]
D2
A2
A
K
C
HCT1
TO1
+Output
Terminal
1
2
3
4
+12
-12
IS
GND
T1
L1
TB3
PCB10
Output Filter
Circuit Board
[WK5358]
TB2
SIDE CHASSIS 4
D3
A1
CC1
TO2
-Output
Terminal
CC2
GAP
R1
R2
HF-UNIT 1
AC1
AC2
EA
SIDE CHASSIS 1
EB
SIDE CHASSIS 2
PCB6
Control 2
Circuit Board
[WK4987]
PCB5
Control 1
Circuit Board
[WK4986]
CN 1
CN 4
CN 5
CN 6
CN 7
PCB4
Panel
Circuit Board
[WK4985]
CN 9
CN 8
TH1
CN 2
26
Art # A-06011

# APPENDIX 4: HARDWARE

| Description | L | A | B | Code No. | Order No. |
|---|---|---|---|---|---|
| Post1 (M4-M5) | 9mm | M4 | M5 | EAA424900 | 10-6669 |
| Post2 (M5-M5) | 11.4mm | M5 | M5 | EBA425000 | 10-6801 |
| Post3 (M5-M5) | 23mm | M5 | M5 | EBA425100 | 10-6802 |
| Post4 (M4-M4) | 20mm | M4 | M4 | EBA431100 | 10-6670 |
| Post5 (M4-M4) | 22mm | M4 | M4 | EBA431200 | 10-6671 |
| Post6 (M5-M5) | 21mm | M5 | M5 | EBA431300 | 10-6672 |
| Post7 (M5-M5) | 20mm | M5 | M5 | EBA435900 | 10-6673 |
| Post8 (M5-M5) | 10mm | M5 | M5 | EBA436000 | 10-6674 |
| Post9 (M5-M5) | 19mm | M5 | M5 | EBA491700 | 10-6750 |
| Post11 (M5-M5) | 9mm | M5 | M5 | EBA643600 | 10-6751 |
| Post421 (M4-M4) | 21mm | M4 | M4 | 53602020600 | 10-6803 |



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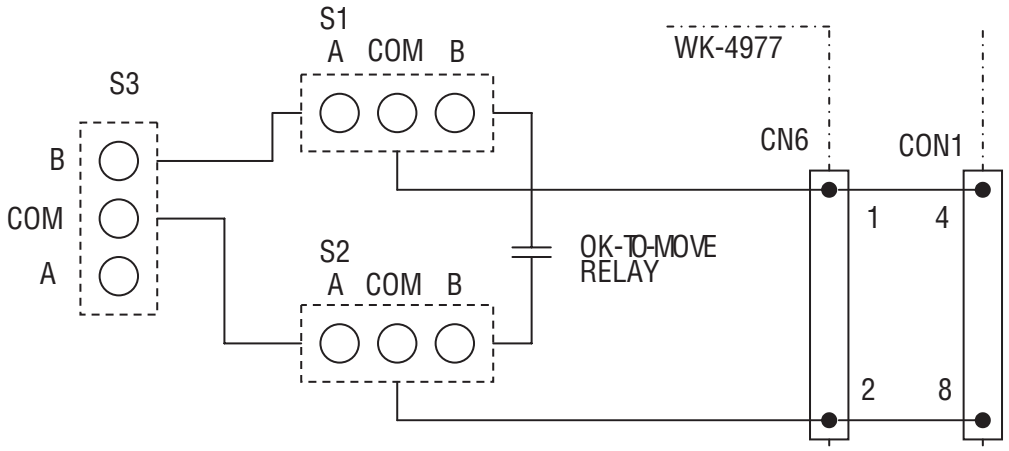
# APPENDIX 5: AUTOMATION

### SLIDE SWITCH SETTING FOR "OK–TO–MOVE". Models 160S/TS

Three slide switches (S1, S2 and S3) are provided on PC Board WK-4977 for automation purposes. This PCB is the units right side main PCB. This PCB can be accessed by removing the side covers by loosening 4 screws on each the front and rear panel, then removing the 4 side panel screws as well as the 2 handle screws. Carefully pull the front and rear panels outward to release and remove the side cover. Lift up the protective PCB cover sheet from the bottom and the slide switches will be accessible through a slot in the PCB Board. See figure on next page for details.

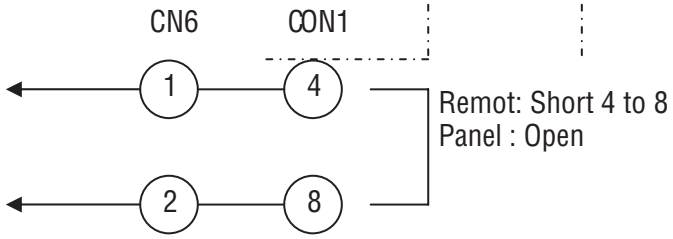
All units are shipped from the factory with the slide switches set in position "A". This is for normal semi-automatic operation utilizing a remote device, such as a foot control. The 8-pin remote operates as described earlier in this manual. Placing all slide switches in position "B" would be primarily used for automation with an arc establish relay, remote amperage and contactor. An arc-establish signal is located from pins 4 and 8 when in this mode.

Placing slide switches S1 and S2 in "B" position and slide switch S3 in "A" position would have the configuration of an arc-establish signal and remote contactor, but the unit's front panel would control the amperage.



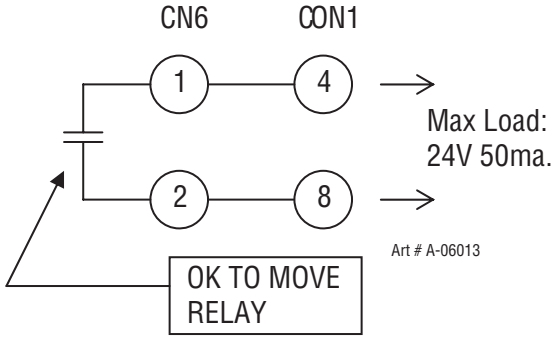

• Set All "A" positions: factory shipping

| | POSITION |
|---|---|
| S1 | A |
| S2 | A |
| S3 | A |




• Use "OK TO MOVE" signal

| | POSITION | |
|---|---|---|
| S1 | B | B |
| S2 | B | B |
| S3 | B | A |
| A/V | REMOTE | PANEL |



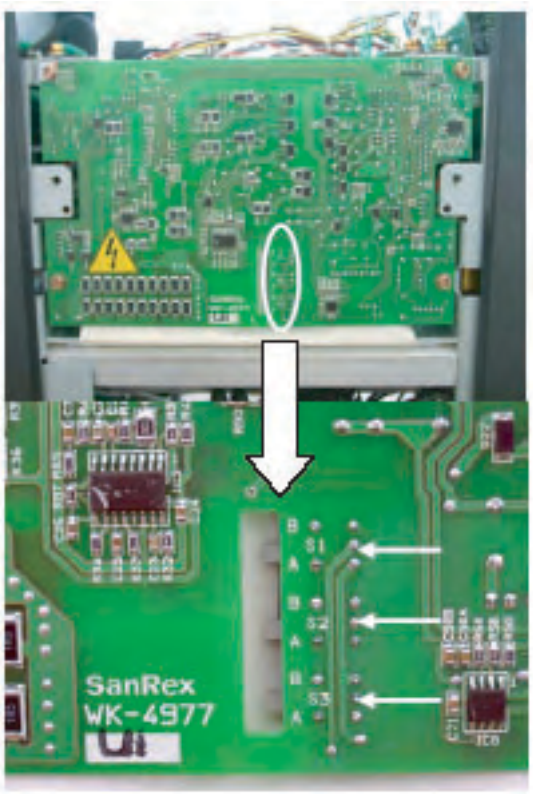



Figure A-4: Slide switch location.

# APPENDIX 6: DIODE TESTING BASICS

Testing of diode modules requires a digital Volt/Ohmmeter that has a diode test scale.

1. Locate the diode module to be tested.
2. Remove cables from mounting studs on diodes to isolate them within the module.
3. Set the digital volt/ohm meter to the diode test scale.
4. Using figure A-6 and A-7, check each diode in the module. Each diode must be checked in both the forward bias (positive to negative) and reverse bias (negative to positive) direction.
5. To check the diode in the forward bias direction, connect the volt/ ohm meter positive lead to the anode (positive, +) of the diode and the negative lead to the cathode (negative, -) of the diode (refer to figure A-6). A properly functioning diode will conduct in the forward bias direction, and will indicate between 0.3 and 0.9 volts.
6. To check the diode in the reverse bias direction, reverse the meter leads (refer to figure A-6). A properly functioning diode will block current flow in the reverse bias direction, and depending on the meter function, will indicate an open or “OL”.
7. If any diode in the module tests as faulty, replace the diode module.
8. Reconnect all cables to the proper terminals.

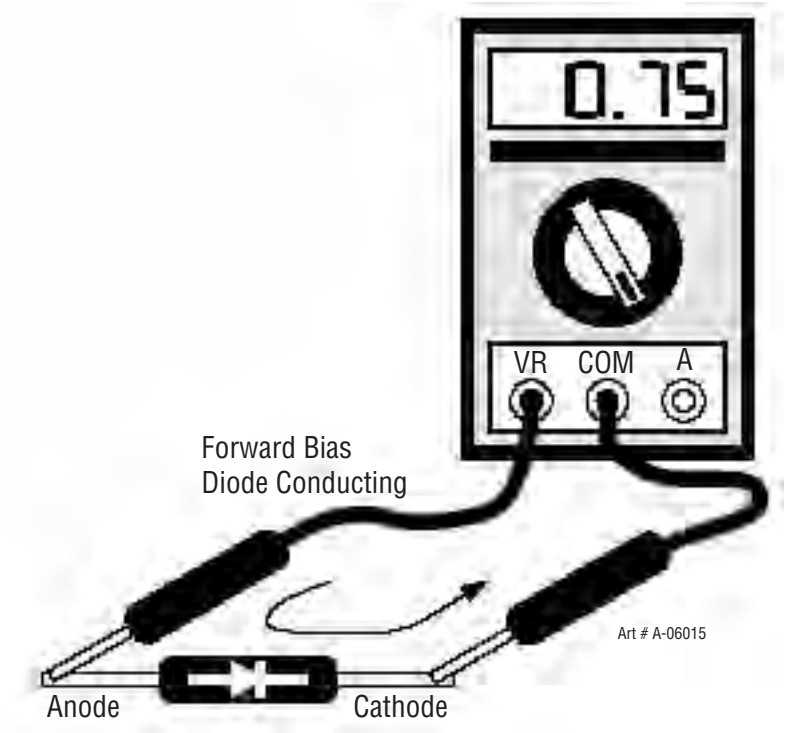



Figure A-6: Forward bias diode test.

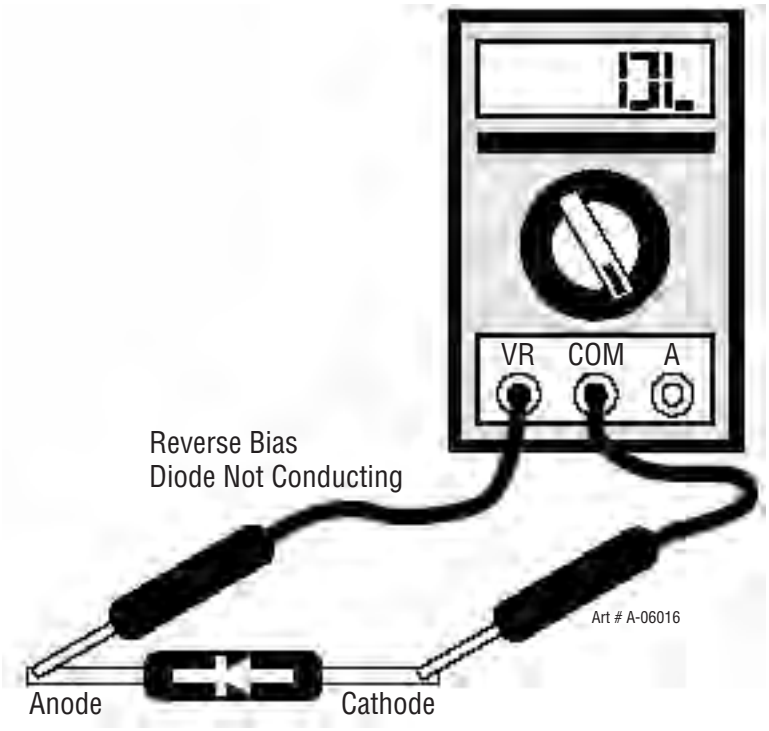



Figure A-7: Reverse bias diode test

THERMAL ARC®

**Global Customer Service Contact Information**

**Thermadyne USA**
82 Benning Street
West Lebanon, NH 03784 USA
Telephone: (603) 298-5711
800-752-7621
Fax: 800-221-4401
Email: sales@thermalarc.com

**Thermadyne Victor Brasil**
Avenida Brasil
13629-Cordovil
Rio de Janeiro, Brazil 21012-351
Telephone: 55-21-2485-8998
Fax: 55-21-2-485-8735

**Thermadyne Chile**
Piloto Lazo #90
Cerrillos
Santiago, Chile 7278-654
Telephone: 56-2-557-2465
Fax: 56-2-557-5349

**Thermadyne Europe**
Europe Building
Chorley North Industrial Park
Chorley, Lancashire
England, PR6 7Bx
Telephone: 44-1257-261755
Fax: 44-1257-224800

**Thermadyne Asia Pacific Pte Ltd**
5 Shenton Way
#37-02 / 38-02 UIC Building
Singapore 068808
Telephone: 65-6832-8066
Fax : 65+ 6763 5812

**Thermadyne, China**
RM 102A
685 Ding Xi Rd
Chang Ning District
Shanghai, PR, 200052
Telephone: 86-21-69171135
Fax: 86-21-69171139

**Thermadyne Asia Sdn Bhd**
Lot 151, Jalan Industri 3/5A
Rawang Integrated Industrial Park - Jln Batu Arang
48000 Rawang Selangor Darul Ehsan
West Malaysia
Telephone: 603+ 6092 2988
Fax : 603+ 6092 1085

**Cigweld, Australia**
71 Gower Street
Preston, Victoria
Australia, 3072
Telephone: 61-3-9474-7400
Fax: 61-3-9474-7510

**Corporate Headquarters**
82 Benning Street
West Lebanon, NH 03784 USA
Telephone: (603) 298-5711
800-752-7621
Fascimile: 800-221-4401
Email: sales@thermalarc.com
**www.thermalarc.com**

THERMAL ARC
By THERMADYNE